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THE AMERICAN GAS LIGHT JOURNAL

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THE LAWMAKERS AND THE GAS MEN.

Of course, it is unnecessary to remind our readers, for the simple reason they have had plenty of experience in the premises, that the average legislator is ever on the alert for a chance to "rise in his seat" for the purpose and object of "firing a shot" at the gas man. Come to look at it it seems rather wonderful that so many of the craft have managed to survive the attempts of the legislative marksmen; but the survival may partially be accounted for on the ground that the legislative "gunner," as a rule, does not adhere faithfully to the rules laid down by those who have become adepts in the matter of striking the bull's eye. These reflections, of course, are intended only with reference to his power to do "fatal harm," and, in consequence, have no significance, in truth, are sadly wide of the mark, when his unerring straigtness of aim in "striking" the gas man's treasury is remembered and considered. Every year we are treated to a prolific crop of legislative measures directed against the gas interests of the several States; and perhaps the lawmaking season just finished has been, in that respect, more notable than any of its predecessors. The Empire State may fairly be awarded the palm for unfairness in the course pursued in dealing with the question of gas supply in the metropolis; while the Commonwealth of Massachusetts, through its legislators, may be said to have acted with prudence, fairness, and honesty in these matters which were connected with its gas industry, and which were openly considered within its legislative assembly. Even the Senate of the United States busied itself largely with the operations of one of the two gas companies about which it has the right to speak a word; and, take it altogether, could not have arrived at stupider conclusions than those reached, as evidenced by the full text of the bill presented in other columns of our current issue, if stupidity were the goal which the honorable gentlemen were most anxiously striving to gain. The Ohio Legislature, or at least a small portion of it, the past spring attempted to legally brand every gas man in the Buckeye State as an impostor, but the branding-iron remained uncut and unheated because of a return to sanity on the part of the solon who conceived the project. Far away Colorado also evidenced symptoms of rabidness, but the virus was reduced without an appeal to Pasteur. Other State Assemblies exhibited more or less leaning toward the passage of "restrictive measures," but in the main the various proposed enactments failed to receive official consent—always excepting the State of New York.

Among the list of measures which "died before they were born" was a most peculiar sample, submitted in January last, by Mr. Harrigan, to the New Jersey House of Representatives. It appears that "business had been rather dull in the House," and Mr. Harrigan, perhaps with an eye to the location of "windward anchors," but possibly to dispel the *ennui* which oppressed him, "rose in his seat" to "voice" the following statement. Beginning with an appropriate "whereas," Mr. Harrigan explained that, "The citizens and residents of numerous cities and towns of this State complain loudly of oppression and grievances caused them by the grossly extortionate rates charged by gas light companies for gas furnished consumers, and that such gas is of an inferior and unfit illuminating power, and that their complaints and protests against such abuses are met by crafty and fraudulent pretensions of reductions in rates charged, while in fact any reduction in price of gas is more than offset by changes in the quality of such gas, and the additional pressure applied on the mains of such gas light company; *and whereas*, it is openly charged that the net profits realized by

said gas light companies are far in excess of a reasonable, just or legitimate revenue on the small amount of capital so invested, and if the allegations are true in that behalf, show the practice of systematic fraud on the citizens" (Mr. Harrigan included) "such as to shock the conscience and judgment of all fair-minded people, and to call aloud for immediate correction and remedy by the lawmaking power of the State; and to that end it becomes proper and right that a thorough and speedy investigation be made by the representatives of the people in this the popular branch of their State Legislature of the current reports of alleged frauds and extortions practiced upon the citizens of this State, and the actings and doings of said gas light companies," etc. The tail sections of Mr. Harrigan's bantling provide for the appointment of a joint committee, and the manner in which the investigators' fees are to be assessed and collected.

We mention this Harrigan monstrosity at such length simply because we would like to put him on record so that he may be known for what he is, and also for the reason that those who are interested in the passage of gas commission laws may not sleep too long at their posts. Even if Harrigan did not succeed in convincing his brother legislators that his resolutions should be adopted, the fact still remains that they were offered and received consideration—sufficient in itself to prove that those intended to be affected ought to be up and doing.

GENERAL HICKENLOOPER'S ARGUMENT.

Owing to the alertness of "Retort," our Western correspondent, we were enabled to give, in our issue for August 2d, a summary of General Andrew Hickenlooper's singularly telling and able argument before the Committee on Light, of the Municipal Council of Cincinnati, Ohio, in the matter of the lighting propositions submitted to the authorities by the manipulators of the Ohio division of the Edison system of incandescent electric lighting. Our summary, while it may be said to contain the most prominent points made by the General, of course omitted much that is of value and interest to the fraternity; and we are pleased to be now in position to state that Messrs. Robert Clarke & Co., of 61 to 65 West Fourth street, Cincinnati, have republished the article in a form at once suitable and convenient, and announce themselves in readiness to supply an unlimited number of copies to those in the gas business who may now or hereafter find themselves in conflict with the Edison schemers. The pamphlet covers 95 pages, and is an excellent specimen of typography. The prices fixed by the publishers are as follows: 50 copies, $12.50; 100 copies, $22.50; 250 copies, $50; 500 copies, $87.50. Single copies will be charged for at the rate of 50 cents each. If our subscribers would prefer sending their orders to the JOURNAL office, we will promptly fill the same at publisher's net figures. It may be accepted as certain that that warlike handle to the name of the President of the Cincinnati Gas Light and Coke Company was not put there for ornament only. Not much; as other Ohio manipulators, who sought to get in their fine work in the General's direction at divers periods, have found out to their discomfiture.

SATISFIED GAS MEN IN MONTREAL, CANADA.

We have received the following interesting letter from Mr. Scriver, Secretary and Treasurer of the Montreal Gas Light Company, which conveys a most valuable moral. The Secretary says:

"Since the reduction made in selling price of gas in Montreal, which took effect in May, 1885, the demand for the product has increased to such an extent that the gas company's managers have been compelled to make provision for the erection of an additional holder at their new station in the eastern division of the city. This holder is to be of the telescopic order, with two lifts. It will have a diameter of 124 feet, and each lift is to be 24 feet in depth. The tank (of brick) and foundation walls of building are now being laid. The building, which will be of brick, will be commenced early in the spring of 1887, and will be covered by an iron roof. A large purifier has recently been added to the plant of the old west station, while other improvements there include the erection of a 60-foot scrubber, and a large addition to the capacity of the coal storage sheds. All this has been done in the face of the incoming of the electric light, which is now being used on some of the streets, and which cannot be said to give satisfaction. The poles are placed at distances of 360 feet, and midway between the arcs, especially where trees intervene, darkness prevails. Electric light stock in Montreal is freely offered, in quantities, at 50 to 55 cents on the dollar, while gas stock sells at 209 to 210. The public may draw their own conclusions." To which we may say, "So can the gas men."

On the evening of August 6th the Beverly (N. J.) Council agreed to proposals submitted by the proprietors of the Gloucester Iron Works, under which Beverly will be lighted with gas at a date in the near future.

[Communicated to the JOURNAL.]

Some Facts About the Gas Meter.

By CHAS. W. HINMAN,
Inspector of Gas and Gas Meters for the State of Massachusetts.

The gas meter has long been the butt for numerous jokes from the funny men of the newspapers. The alleged monotonous buzz of its rapidly revolving wheels has been held up to the public as the nearest approach to perpetual motion yet discovered; and the utterance "lies like a gas meter" is considered about the most forcible expression used for indicating want of veracity. The public are treated to any number of accounts of persons who, having been absent for the whole quarter, have had a gas bill (of the same size as that of the former year) presented to them on their return.

A recent number of the New York *Tribune* has stated, as an official corroboration of the charges of inaccuracy made against the gas meter, that the City Inspector at Washington, D. C., lately testified, before a Government committee, that of 150 meters tested two-thirds were found to register more gas than really passed through them.

On the other hand, the public are met with the statements of some gas men that the gas meter is an almost infallible instrument, whose accuracy is greater than almost any other measuring machine, even exceeding the watch.

How to measure gas accurately is not a particularly easy problem to solve. Gas differs from most commodities in being very susceptible to the influence of heat and pressure. If a man bought a thousand feet of gas and had it measured out to him at a barometric pressure of 28 inches of mercury and a temperature of 100° F., he would get only about four-fifths as much as when the temperature was at the freezing point and the pressure at 30 inches.

Although the changes in volume of gas, due to changes of temperature and pressure, are so considerable, still the average temperature and pressure of any given place varies so little from year to year that no injustice to either the consumer or the gas company results if the temperature and pressure are considered constant. Consumers occasionally get less gas than they pay for, as they sometimes place the meter where it is kept hot on account of proximity to furnace or steam pipes. Besides causing the gas to expand, the heat is apt to cause the diaphragms of the meter to harden and contract, and so, through his own negligence or ignorance, the consumer obtains scanty measurement. Neither is it desirable to place a meter where it is liable to be much colder than the entering gas. Otherwise, the moisture in the gas will condense and gradually fill the meter with liquid.

I do not understand how the Washington Inspector can have arrived at a result so unfavorable to the accuracy of the gas meter, as he is stated (by the *Tribune*) to have done. My own experience, which has extended over quite a number of years, and which has been gained by testing meters from most of the cities and towns of Massachusetts, has been much more favorable to the reliability of the gas meters.

The Massachusetts law relating to the inspection of gas meters was passed 25 years ago, and has remained practically the same since then. It provides that every meter shall be inspected by the State Inspector before being used, and also after being repaired. If at any time any consumer thinks his meter has become incorrect, he can have it reinspected. If the meter is then found to be wrong the consumer pays nothing, and is furnished with a correct meter; if the meter is correct he pays a small fee, and also the expense of removing and resetting the meter.

Of late years, out of about 100,000 consumers only from 100 to 200 per year have suspected their meters strongly enough to have them inspected. Some of the meters are brought for reinspection by the gas company; but the Inspector usually does not know which party suspects the meter. It must be borne in mind that these meters are not a fair average of those in use—for someone has had reason for thinking they were incorrect, or else they would not be brought for reinspection.

During the past 10 years 1,917 meters have been brought to me for reinspection. This is nearly thirteen times as many meters as the Washington inspector is said to have examined. Of this number 671 meters were more than 2 per cent. fast—the average error being 4.96 per cent. One-half the the whole number, or 950 meters, came within the limit of 2 per cent. allowed by law, and 278 meters were more than 2 per cent. slow—the average error being 9.56 per cent. The other meters, 18 in number, would not register, although some of them would pass gas. The average error of all the meters examined was 0.35 per cent. fast.

For some years past, owing probably to the fact that the gas has been better purified from ammonia and tar, there has been a gradual gain in the accuracy of suspected meters. If instead of the last 10 years the last 5 years are taken, it is found that in place of the average of all the meters being one-third of one per cent. fast, the record proves them to have been 0.09 per cent. slow. In these 5 years 188 meters averaged 4.72 per cent. fast; 323 were correct; and 107 averaged 8.80 per cent. slow. On comparing the 5 years

preceding 1886 with the 5 years preceding 1881, we find for the later period a larger proportion of correct meters; and that the average error of both fast and slow meters is less than for the earlier period. The number of complaints has also diminished largely, only one-half as many having been made during the last five years as were made during the preceding five.

Although more meters are found to be fast than slow, yet if only serious errors are considered the contrary is found to be the case. During the past three years 460 suspected meters were brought to this office for reinspection. Of these 30 were found to be more than 5 per cent. slow, and only 25 more than five per cent. fast. Only 5 were more than 10 per cent. fast—the greatest error being 17 per cent.; while 14 were more than 10 per cent. slow—one meter registering only one foot for every four feet of gas that passed. Out of these 460 meters I have also made note of those which were in use twelve years or more before being reinspected. Of these meters, 72 in number, 20 were fast, 32 correct, and 20 were slow. This shows that the proportion of fast to correct meters is about the same however long the meters have been in use; and that the proportion of slow meters is about twice as great as the general average when the meters have been in use for a long time. The meters which were more than 10 per cent. fast had been in use, on the average, a little more than six years, while the meters that were more than 10 per cent. slow had been in use, on the average, twelve years.

As an additional proof that the meters, on the average, are no faster than they ought to be, may be mentioned the fact that no gas company sells as much gas as its station meter registers; but in fact all of them sell from five to twenty per cent. less. As far as the gas company is concerned there can be no doubt but what, in the aggregate, it gets pay for no more gas than it delivers. Of course, it is the duty of every gas company to have its meters as nearly correct as possible; it has no right to charge any consumer for more gas than he gets, even if it charges some other man for less gas than he uses.

Greater accuracy would be secured if the meters were periodically tested. Although such a testing would cost some money, yet the consumers would be better satisfied, and the company would probably lose nothing in the end.

There is no reason why most well-made gas meters, if kept continuously at work measuring well-purified gas, at a tolerably uniform, moderate temperature, should not be accurate at the end of ten or fifteen years. I have occasionally had meters brought in for reinspection that had been in use for a still longer time, and yet were correct and serviceable.

Much more attention is now given to removing tar and ammonia from gas than was formerly the case. Tar is liable to stiffen the diaphragms and clog the valves of the meters, while ammonia not only stiffens the diaphragms but causes them to rot. Some small companies furnishing a rich gas made from petroleum are the worst offenders as regards the leaving of tar in their gas.

Of course, anything which tends to stiffen the diaphragms shortens the stroke of the meter, and so causes it to go fast; but if the diaphragms get too stiff the meter will not work. If the valves lift, or any hole is made, the gas escapes without causing the mechanism to move.

It may be asked why, if gas meters are such reliable instruments, we should hear so much complaint about them? It must be remembered, although there are a great number of complaints, that the number of complained-of meters forms but a fraction of one per cent. of the total number in use. It has always seemed to me that the principal reason for the popular distrust of the gas meter was that the public did not understand its construction. When a person buys a yard of cloth, a bushel of potatoes, or a pound of meat, he can readily understand the principle of the measurement, and either see the operation performed or verify it himself afterwards. With gas the consumer can neither see the measurement nor verify it without considerable trouble; and he usually does not understand the principle on which it is based. He only sees that his gas passes through a plain tin box, provided with a small index, and that there comes a bill for gas, which is frequently larger than he thinks it ought to be.

A fruitful cause for complaints about meters is found in the burners. An old burner, if it has an iron or brass tip, is frequently burned out or worn so as to consume much more gas than it did when new, and not to as good advantage. Non-corrosive tips are frequently allowed to clog up, and thus give badly proportioned flames, causing much more gas to be burned to give the requisite amount of light. Sometimes, however, it is a change of burners which causes the meter to be mistrusted. A limber-tongued traveling burner man dilates on the economy of his patent "quadruplex elliptic" gas burner, and produces a certificate, from the celebrated Professor Blank, purporting to show that the said burner will consume only half the gas and give twice the light afforded by an ordinary burner. The burner man shows the consumer the marks on the burner indicating that it burns three feet per hour. The consumer admits that the new burner gives a better light than his old one, still he does not know that the new burner easily consumes seven feet of gas per hour.

Sometimes the servants burn much more gas than the owner of the house is aware of. Occasionally a person leaves his house shut up for the summer, but accidentally leaves a burner lighted during his absence. There may be a leak in the fixtures, and the gas escapes where it will not be detected by the odor. There may be a mistake in reading the meter, or the state of the meter may be taken at irregular intervals. A person frequently compares his gas bill with his neighbor's, and finds it considerably larger; but his neighbor's meter may be slow instead of his own being fast—supposing the comparison is fairly made in other respects. Occasionally the weather is much darker than the average, and so the gas is extinguished later and lighted sooner than is generally the case for the time of year.

These various causes, as well as others, tend to discredit the accuracy of the gas meter; but it is probable the consumer gets better measurement of his gas than of the average of his provisions and groceries.

[Official Report—Concluded from page 70.]

Ninth Annual Meeting of the Western Gas Association.

Held at the Neil House, Columbus, Ohio, May 12 and 13, 1886.

Second Day—Afternoon Session.

Mr. Emerson McMillin, of Columbus, Ohio, read the following paper on the subject of—

THE FLOW OF NATURAL GAS.

The average person, or one with no experience in the matter, can only give the wildest guess when called upon to estimate as to the quantity of gas issuing from a natural gas well; and it is an easy and common thing for those experienced in the line of estimating (not measuring) to be greatly mistaken.

When one stands beside an open six-inch casing, and can barely feel with his naked hand the escaping gas, he very naturally concludes "the well don't amount to much." Yet when the flow is carefully measured by methods hereafter described the yield may prove to equal a round million cubic feet per day. Again, when one stands near a "gusher," with a three or four-inch opening, and finds it necessary to protect the drums of his ears by stuffing the auricular cavities with cotton, and when the roar of escaping gas makes it impossible to carry on conversation in the vicinity of the discharge orifice, he is then quite liable to conclude that there are hundreds of feet of gas escaping from this well for every single foot escaping from the one first mentioned. Here a careful calculation of the flow will again show how one's senses are prone to deceive.

While we are not blessed with natural gas wells in this locality, it has been the writer's good fortune to have had the opportunity of accompanying, on several expeditions to the Findlay field, Dr. Edward Orton, our Chief State Geologist; S. W. Robinson, Prof. of Mechanical Engineering, Ohio State University; and Prof. Curtis C. Howard, Analytical Chemist at Starling Medical College, this city, and to lend a little assistance in making a great many careful measurements of the flow of gas from wells in that locality; testing the formula laid down in our text books for calculating the flow of gases; also in trying and proving what, so far as I know, were heretofore untried methods of determining the discharge and flow of gases. That work was all performed in the interest and for the Geological Survey of Ohio; and it is through the kindness of the Chief Geologist, Dr. Edward Orton, that I am permitted to present these facts to you.

The first method tried was that of measuring the discharge with an anemometer or air meter. Some of you may not have had an occasion to use this instrument, and, therefore, may be interested in seeing its operation. I have one here; and by substituting my mouth for the other and (at present) less convenient natural gas well, I can give you an idea of how rapidly the hands of the dial are made to spin when it is placed in the current of a well flowing a million cubic feet per day. These dials are made to record cubic feet passing per minute through an opening 12 inches square. Now, if we hold this to the open end of a 4-inch pipe, and it records 3,000 feet per minute, then we must, to reduce the *apparent* to the real flow, square the 4-inch pipe, which gives us a sectional area of 12.5 inches. Now, by multiplying the 3,000 feet by 12.5, and by dividing the product by 144—the area of 12 inches square—the quotient will be the actual or *true* quantity of gas passing per minute. In the instance given it would be 260 feet per minute, or, in round figures, 275,000 cubic feet per day. To be exact, however, with this instrument, we must add 30 to the reading, for correction of error in its record, making the apparent flow 3,030 feet per minute. When the velocity is so great that the instrument is required to register more than 3,000 feet per minute, it is best to reduce the velocity by enlarging the orifice. This is done by placing over the end of the discharge pipe a sheet iron pipe, or wooden box, that fits neatly over the discharge, but which becomes larger in its sectional area as it extends away from the discharge pipe, making it

conform in shape, as nearly as possible, to the form the column of gas assumes in escaping into the open air. The pipe would be in this shape:

At small end, 4 inches; at large end, 12 inches. If the velocity is very great this additional pipe must be correspondingly long. You will readily see how the velocity would be reduced at the outer end of this added pipe. The added pipe being three feet in length, the velocity would be nine times greater at the small than at the large end. In the absence of this precautionary measure the veins of the anemometer may be torn out and the instrument greatly damaged, if not destroyed.

This mode of measuring gas wells had not, to our knowledge, been used by others, and there naturally lingered a doubt in our minds as to its accuracy. The instrument of the size which I have shown you was used, and also a much larger one belonging to Dr. Orton.

During a recent trip to Findlay we measured what is known as the Jones well. We took some eight or nine readings, which varied a little as the instrument was placed in various positions in the orifice of the pipe; but when the averages of the several readings were taken they showed exactly, or to a foot, the same discharge per day as was shown by Prof. Orton's instrument some two weeks previously. The flow equaled 1,159,280 feet in 24 hours. Before this same well was drilled to its present depth the flow was tested with the anemometer, and also calculated by the formula in use by gas engineers, the pressure being ascertained by an improvised pressure gauge of the U-tube pattern. These measurements I give somewhat in detail. Four readings of the anemometer showed 2,748, 2,849, 2,834, 2,852—the average, being 2,821, plus 30 (for correction) equals 2,851. This sum multiplied by the area of the pipe (5⅛ inches in diameter), 24.85 inches, equals 70,847, divided by 144 (area of 12 inches square), equals 492 cubic feet per minute. That multiplied by 60 equals 29,520 feet per hour, and again multiplied by 24, equals 708,480 feet per day.

The pressure equaled three-eighths of an inch water column, as nearly as it could be measured with a rule. Using this figure as the pressure we will calculate the flow by this formula:

$$q = 1350 \quad d^2 \sqrt{\frac{hd}{S(l+d)}}$$

where q = quantity, in cubic feet, of gas per hour.
l = length of pipe, in yards.
d = diameter of pipe, in inches.
h = head or pressure, in inches, of water.
s = specific gravity of gas, air being 1.
1,350 = coefficient of friction.

Then $375h \times 5.625d = 2.11 \div (58s \times 0l + 5.625d) = .628$. $\sqrt{\ } = 7.925 \times 1{,}350\,constant \times 31.44d^2 = 33{,}855$ feet discharge per hour $\times 24 = 812{,}520$ feet per day, or 13 per cent. more than was indicated by the anemometer.

This would appear discouraging were it not a fact that there was an opening at right angles to the discharge pipe before it reached the anemometer, and in a position where the quantity escaping could not be ascertained. On the other hand the pressure gauge was placed in the gas before it had reached this opening.

While these tests were satisfactory to the parties making them, they must needs be substantiated before either mode of measurement can be relied upon. We, therefore, give other instances where the conditions were equal, or with no uncertain interfering elements, such as side openings, etc.

Another well shows, as an average of three readings of the anemometer, 3,112; add, for correction of instrument, 30 = 3,142. The gas was escaping from a 2½-inch pipe, on the end of which was a coupling 2¾ inches in diameter. The area of the end of coupling, where anemometer was held, equaled 5.94 inches. This $\times 3{,}142 = 18{,}663 \div 144 = 129.61$ feet per minute $\times 60 =$ 7,776 feet per hour $\times 24 = 186{,}624$ feet per day.

The pressure in the end of the coupling equaled $\frac{7}{16}$ inch water column. Testing by the formula given above, we get by calculation the following result: $.4375h \times 2.75d = 1.203 \div (.58s \times 0l + 2.75d) = 1.595$. $\sqrt{\ } = .752 \times 7.5625d^2 \times 1{,}350 = 7677.45$ feet per hour $\times 24 = 184{,}250$ per day, or within 2,450 feet of the quantity indicated by the anemometer. The pressure back in the 2½-inch tube equaled a half-inch water column. Using the same formula as before, but calculating from an increased pressure and reduced sectional area, the result showed a discharge of 187,920 cubic feet. We have been rating the gas as having a specific gravity of 0.58; but at this particular well there was a noticeable quantity of oil vapor, which possibly increased the specific gravity somewhat. Rating s as 60 instead of 58, the discharge equals, by the last calculation, 184,680 cubic feet per day.

These numerous tests prove conclusively, I think, that either both modes of measurement may be relied upon, or that both are faulty, as they practically give the same results.

The value of the formula for calculating the flow of gas (under higher pressure) was subjected to another test. An accurate steam gauge was attached at a point 21 feet 2 inches from the end of a 2-inch pipe full open, and the pressure of the gas stood at 16 pounds on the gauge. You will have observed in the former calculations that l, or "length" has been represented by a cypher, there really having been no "length;" but with this two-inch pipe we have 7.4 yards of length. The rule requires that the diameter of pipe be added to the length, except when the length exceeds 400 diameters; in that case the diameter is ignored. To put this calculation on an equal footing with the others, I add $\frac{2}{10}$ of the diameter (the length of the pipe being $\frac{1}{10}$ of 400 diameters), which is 0.6 of an inch. One pound pressure is estimated to be equal to 27.6 inches of water column. This multiplied by 16 gives us 442 inches of head. Then

$$\sqrt{\frac{442 \times 2}{.58 \times (7.4+6)}} = 13.665 \times 4d^2 \times 1{,}350\ constant = \text{quantity, or } 74{,}439$$

feet per hour $\times 24 = 1{,}786{,}434$ feet per day.

By inserting a small tube in the open end of the two-inch pipe, the pressure was ascertained to be 7.75 pounds. The pressure would vary a little as the small tube was moved nearer to or further from the sides of the two-inch pipe. Now, if the formula is reliable, we should get about the same results, when calculating with the reduced pressure and no length, as were attained in the last calculation: 7.75 pounds $\times 27.6 = 213$ inches as the water head. Then,

$$\sqrt{\frac{213 \times 2}{.58 \times (0+2)}} = 13.665 \times 4d^2 \times 1{,}350 = \text{quantity, or } 73{,}791 \text{ feet per}$$

hour $\times 24 = 1{,}770{,}984$ feet per day.

The result is but little different from the other calculation; and that difference may be accounted for by the fact that there was an open valve between the points where the pressures were taken, and this valve did not have the full capacity of the pipe.

The Karg well showed pressure on the steam gauge, with the tube inserted in the open 4-inch pipe, of a maximum of 15 pounds. When the small tube would be placed near the sides of the cast pipe the pressure would fall to as low as 9 pounds. Moved away from the sides it would gradually rise until, when about one inch from the side, it would reach 15 pounds. The average pressure I rate at 12½ pounds per square inch. This is equal to a head of 358.8 inches. The open end of pipe measured four inches in diameter. Then—

$$\sqrt{\frac{358.8 \times 4}{.58 \times (0+4)}} = 24.9 \times 16d^2 \times 1{,}350\,constant = 537{,}840 \text{ feet per hour}$$

$\times 24 = 12{,}908{,}160$ cubic feet of gas per day.

I have previously mentioned the fact that some systems of measurement were tried which, so far as we knew, had not before been applied to the measurement of gas wells; and also one that was entirely original with Prof. Robinson. I refer to the Pitot tube. This tube is an extremely simple device which Pitot made known to the French Academy of Sciences in 1732, and which represented that, "When a bent or elbow tube is placed in a stream of water, with the open mouth of tube leading up stream, the water will rush against the open mouth and raise the water in the upward turned branch of the tube above the level of the surface of the water a height, h, such that the velocity of the water in the stream will be $v^2 = 2gh$, where g is the acceleration of gravity." More recently the tube, under an improved form, has been successfully applied in the gauging of streams of water, but has never been applied in the measurement of gas or air until now, except in one instance, or about 1873. Prof. Robinson then made use of it with low pressure air. I have a tube here which you can see is very simple. With high pressure wells Prof. Robinson uses a delicate steam pressure gauge, and with low pressure wells he uses the U-shaped gauge (with which every gas man is familiar), though he finds it convenient to use long rubber to connect the two glass legs of the gauge so they can be moved up and down to almost any desired length.

Converting this water column or head, as shown by the water gauge, into a gas column or head, that value of h may be used in the above formula. If the water head be in inches (other dimensions in feet), $2g = 64.3$; then—

$$v^2 = \frac{64.3}{.0807\,Sg.\frac{T_0}{T}} \quad \frac{62.4}{12}h$$

$$\text{Or, } v = \left(1 + \frac{t}{546+t}\right)64.37\sqrt{\frac{h}{Sg.}} \text{ Cent.°}$$

$$\left(1 + \frac{t-32°}{.954+t}\right)64.37\sqrt{\frac{h}{Sg.}} \text{ Fahr.°}$$

—where $Sg.$ is the specific gravity of the gas, air being 1; .0807 the weight of a cubic foot of air at 0° C.; 62.4 the weight of a cubic foot of water; and

t the temperature of the flowing gas in the mouth of the well. Taking the temperature t at 0° C., as found to be the case for a fair value at Findlay wells, and taking $Sg. = .6$, the above reduces to

$$v = 83.08\sqrt{h}$$

This same formula for the same stream of gas flowing through openings of different size gave the following results:

	h	v	Diam.	Cu. ft. per day.
1st.	0.48 in.	57.7	2¾	206,100
2d.	0.5625	62.6	2½	184,400
3d.	29.00	449.5	1⅛	186,200

You will observe how nearly these measurements correspond with the ones previously given, and which were calculated by a different formula, as also ascertained by the anemometer. Professor Robinson's formula gives for the Jones' well, at Findlay, 1,181,350 feet flow, while measurements made at different times by different anemometers gave each time 1,159,200 feet as the daily discharge. When it is known how difficult it is to get a correct average pressure of the gas flow, it will be seen that these measurements are as nearly in accord as could be expected. The length of this paper will prevent me giving you all the formula that Prof. Robinson uses. He has compiled a table which greatly facilitates calculations. The Professor, I understand, will read a paper at the meeting of the Society of Mechanical Engineers, to be held this month at Chicago. I think you will all find it interesting and profitable to get a copy of that paper.

Prof. Robinson also estimated the flow of gas by a "shunt," throwing the gas stream into a gas bag through a non-resistance tube. This form of tube is absolutely necessary in the "shunt" measurement, but not necessary in the other mode, where there is no current through the pipe. In a test of the Cory well, by Pitot's tube, a velocity of 1,178 feet per second was found. By the "shunt" a velocity of 1,111 feet per second was shown.

While the various modes of measurement and various formulæ for calculating the flow of gas wells give us almost identical results, there is one question of transcendant importance, about which the staff of the Geological Survey are not a unit in opinion. You will not think the expression extravagant when I tell you that a well giving off gas at a pressure of 15 lbs. per square inch will be rated by some parties at 12,500,000 feet, and by some others at 25,000,000 cubic feet per day.

We can agree as to the quantity of gas of the density at which it leaves the pipe; but what is that density when 15 pounds pressure is indicated on a gauge attached to a tube inserted in the open end of discharge pipe. The highest authority upon such matters in the Survey says that while the gas rushing out of the pipe shows a pressure of 15 lbs. on the gauge, it is dynamic and not static pressure. That in fact the gas is practically at atmospheric pressure, and that the volume does not materially change after it escapes. Others much less competent to determine a question of this character have been disposed to think that for every cubic foot of gas escaping under a pressure of 15 lbs. above the atmosphere there will be two cubic feet if placed in a counter balanced holder, and after it has attained normal temperature.

The temperature of the flowing gas was taken at but one well. There it varied from some cause which did not occur to us at the time, but which I now think was due to the position in which the thermometer was held. The temperature ranged from 6° below to 5° above zero, Cent.—equal to 21° and 41° respectively of Fahrenheit scale. I have heretofore understood that the temperature of natural gas, from the wells about Pittsburgh, Pa., was 42° Fahr.

Prof. Howard has made a number of analyses of the Findlay gas, and some of them, at least, with great care and accuracy; and the result of his analyses shows the average composition of the gas to be as follows:

Hydrogen	2.18
Marsh gas	92.60
Olefiant gas	.31
Carbon monoxide	.50
Carbon dioxide	.26
Oxygen	.34
Nitrogen	3.61
Hydrogen sulphide	.20
Total	100.00

Sulphur in 100 cubic feet equals 125.8 grains.

I think the partial analyses, made from time to time during the past 15 months, indicate a diminution of hydrogen sulphide. Why this should be I do not understand. The gas for analysis has been taken from different wells, but that could not account for the reduced quantity of hydrogen sulphide, as there seems to be a free flow, or connection, from the bottom of all the wells. When the discharge pipes from any of the wells are closed, the pressure runs up to 400 lbs. per square inch. Of course, some of the wells require longer time to reach the maximum pressure than do others.

Some curious ideas prevail respecting the distance over which natural gas can be transported. Some parties are ready with pencil to figure for you in a moment just how far the gas from any well can be transported so soon as the pressure is known. They tell you the loss of pressure is seven pounds per mile, and, therefore, if you have but 140 pounds pressure you can only send the gas 20 miles. Of course I need not tell you, gentlemen, that the loss of pressure per mile will depend upon the size of the pipe and the velocity at which you are forcing the gas along the pipe.

We hear of companies being organized every day to transport gas over long distances—from 20 to 150, and even 300 miles. In many instances I believe they have not stopped to count the cost. One cannot, without figuring, realize the difference in cost per mile in piping 24,000,000 feet per day 25 miles, and for piping the same quantity 75 miles.

Assuming that the gas has a specific gravity of .60 and an initial pressure of 200 lbs. per square inch, then, with the formula—

$$d = \sqrt[5]{\frac{q^2 s l}{(1{,}350)^2 h}}$$

we get the equation:

$$\sqrt[5]{\frac{1{,}000{,}000 \times 1{,}000{,}000 \times 60 \times 44{,}000}{1{,}350 \times 1{,}350 \times 5{,}520}} = 19+$$

The quotient represents the diameter, in inches, of size of pipe required. Cast iron pipe of this diameter, and .75 inches thick, made in 12 feet lengths, will weigh, including hub or bowl, about 170 lbs. per lineal foot; and this, for 25 miles, equals 11,220 tons, which at $30 per ton amounts to $336,000.

To determine the size required to deliver 24,000,000 feet per day 75 miles, we have, by the same formula:

$$\sqrt[5]{\frac{1{,}000{,}000 \times 1{,}000{,}000 \times 60 \times 132{,}000}{1{,}350 \times 1{,}350 \times 5{,}520}} = 24, \text{ nearly.}$$

The larger the pipe, of course, the heavier it should be made. We will put the thickness of the 24-inch pipe at ⅞ inch, and its weight at 250 lbs. per foot, or a total of 49,000 tons, which at $30 per ton equals $1,485,000. Or, in other words, it would cost about 50 per cent. more per mile for the long than for the short distance. I do not discuss the question here as to whether cast iron pipe, worked under heavy initial pressure, is the most economical mode of transporting 24,000,000 feet of gas per day for long distances; but the ratio of cost between the sizes necessary for the long and for the short distances would hold good, let the system be such as it may. At present the high pressure lines are almost exclusively of wrought iron pipe.

Col. Thos. P. Roberts, an eminent civil engineer of Pittsburgh, Pa., has just patented a system for low pressure lines. He constructs his pipe out of light sheet iron, about No. 14 gauge, and reduces the pressure down to about that of the atmosphere; and, in fact, on a long line part of it would be below atmospheric pressure, as his system contemplates using exhausters, and will depend much more upon suction than upon force. He lays stress upon the idea that gas can be *exhausted* with the expenditure of less energy than it can be *forced*. In other words, the friction will be much less. He illustrates his principle in this way: "Take a pipe of indefinite length and size filled with soft india-rubber. If we attempt to push it through with a rod of the diameter of the pipe, the force will be lost in condensation and the expansion of the material against the sides of the tube. We might as well attempt to push a cone through a hole of a less size than the cone's greatest diameter. On the other hand, if we take hold of the rubber at the other end of the pipe, its elasticity comes to our aid in pulling through the tube a body even larger than the diameter of the tube, and of indefinite length. In one case compression develops friction and retardation, eventuating at a greater or less distance from the initial point in total stoppage; whereas, as we have shown, tension develops constantly decreasing resistance in line of motion." For passing over elevations he suggests heating the gas on the inlet side and cooling it on the outlet side of the elevation.

A vote of thanks was passed to Mr. McMillin.

The list of papers having been exhausted, the President ordered that the question box be opened.

THE QUESTION BOX.

The first question read was—

"How can gasholders be best protected from rust?"

The President knew of no better policy to be pursued in such case than that of periodical inspection and frequent painting.

Mr. Smith said his views agreed with those of the President; and he thought a holder, in order that it might be kept in good condition, should be painted at least once every year.

Mr. Scofield said the Fort Scott (Kan.) Company's practice was to paint the holders once or twice each twelvemonth.

In conclusion, the President thought the answer to the question might be summed up in the words, "Expenditure of elbow grease."

Then came the query—

"*What is the greatest yield of gas to be obtained per pound of Youghiogheny coal, without any enricher, the product to have an illuminating value of* 16 *candles, and to be registered at* 60° *F.*"

The President thought the maximum yield would average about 5 cubic feet on the works.

Mr. Lansden said his experience indicated a better result than that instanced by the President. Up to about March 1st the speaker had been using a certain percentage of cannel, but no enricher was now employed. He (Mr. Lansden), on an average of 11 days, when a new supply of Youghiogheny had been carbonized, had obtained a yield of 5.25 cubic feet to the pound, and the gas showed, according to his records, an illuminating value of 17.65 candles. The city gas inspector's returns gave a still higher showing of candle power.

Mr. Howard asked if Mr. Lansden's "coal held out," and the latter replied, "Always. My coal is weighed in the retort house, and the scales are proved up every 30 days." He then explained that he worked with a two-inch vacuum on the hydraulic main, and carried a dip of from 2½ to 3 inches. There is how he claimed to enrich his gas, because it had to bubble up through about three inches of tar. In fact, his tar purchasers said the tar contained none of the light oils. He used a steam-jet exhauster, but at the works a Bunsen photometer was in duty, and the gas temperature at the time of estimating the lighting value was corrected to 60° F. and 30 inches barometer.

The third question was—

"*What would be considered a fair yield of gas from a bench of threes when carbonizing Pittsburgh coal?*"

Mr. McMillin thought they should "rule out" benches of threes; and Mr. Hyde said it was impossible to discuss the question, because the propounder failed to give any figures as to the dimensions of the retorts.

The fourth proposition asked whether a

"*Superintendent should be held responsible for the delivery of gas beyond the consumer's meter?*"

Mr. Hyde thought there were cases in which the superintendent should be held responsible, and mentioned the following circumstance (it occurred at Cleveland, Ohio) in support of the assertion: The gas supplied to a railroad depot had for some time been in excess of the quantity necessary for its lighting requirements, and complaint was made in regard thereto. The meter was found to be correct, but the trouble continued. He finally determined on making a personal investigation; and after a protracted search it was discovered that a pipe in an out-of-the-way portion of the depot had become fractured, and thus permitted the escape of a large quantity of gas. Mr. Hyde said the Cleveland Company, while it could not legally, perhaps, have been held responsible for the defect in the depot services, finally concluded to made a reduction in the face of the depot's gas bill; and did so because the depot managers had made complaint some time prior to the search which was instituted by the gas company.

Mr. Harbison disagreed with Mr. Hyde over the fact that the gas company should have made the concession. He did not think a superintendent ought to be held responsible for loss accruing to a consumer because the latter's supply pipes were defective, unless the piping of the building was put in by the gas company. The practice at Hartford, in the matter of piping new buildings, is to insist upon an inspection by the gas company of the work done when the same is reported as completed. The only subsequent connection of the gas company in regard to the services is in the way of advice or suggestion. Mr. Harbison said that a large quantity of gas had escaped in one of the Hartford railway depots, but as the escape was traced to fractured pipes (the breaks were caused by or were owing to the culpability of the railroad folks), the railroad company had to pay for its negligence. Similar instances could be recited in the case of private consumers in Hartford, and they had to foot the bills. In one or two instances, where the loss was particularly heavy, the gas company did share in the expense; but that was an act of generosity on the part of the gas suppliers.

Mr. Hyde said he agreed with Mr. Harbison as far as ordinary leakage was concerned; and he only mentioned the action taken in the particular Cleveland depot case because the gas company had been informed that something was wrong with the gas supply some time previous to the date on which the search was made. Mr. Hyde did not want to be understood as intimating that the Cleveland or any other Company could be legally held responsible for loss occasioned through the negligence of others.

Mr. Harbison said he thought the propounder of the question would have simplified matters if he asked whether a superintendent should be held morally or legally responsible.

The President said it would be impossible to hold a superintendent legally responsible for the culpability of others; and he thought this was rather an important matter, since several gas companies had refused to pipe houses through fear of being held accountable for defects which might subsequently crop out in the work. In his opinion a gas company was not responsible for after-defects in work which had once been accepted; and it was absurd to hint that a superintendent could be held accountable for the carelessness of consumers.

Mr. Howard said that the Dubuque (Iowa) plan was to thoroughly prove the house pipes before placing the meters. Several times he had the meters brought back to the gas company's office simply because the house pipes were not as they should be—and had been roundly abused by the would-be consumers for so doing.

Prof. Douglas said the custom at Ann Arbor (Mich.), when a meter was placed in a building, was to oblige the consumer to sign a written agreement which contained a clause that exempted the company from any responsibility for the gas flow when the same had passed the meter outlet.

This terminated the business proper of the Ninth Annual Convention, and the assembly was declared adjourned.

Are So-Called Elaborate Regenerative Retort Furnaces a Failure?

[A paper read by Mr. R. O. Paterson, of Cheltenham, England, at the Twenty-third Annual General Meeting of the British Gas Institute. Our report of same is reprinted from the columns of the *Journal of Gas Lighting*.]

It is not without some hesitation that I venture to approach the discussion of the question which forms the title of this paper. Although urged by many professional friends, in whose judgment I have confidence, to lay before you my experience in the working of one of the forms of German regenerative furnaces, it is doubtful if the necessity for doing so would have prevailed in my mind, had it not been that on lately reperusing the "Retrospect of the Year 1885," which appeared in the first number of the *Journal of Gas Lighting* for the present year, I felt most strongly that the whole truth in the matter of regenerative furnaces has been sadly misunderstood, and that, owing to the unequivocal condemnation of them on grounds which are shown from practical experience to be utterly untenable, a grievous blow has been dealt to the further development of the system, which, coming from the talented and usually well-balanced pen of the Editor of the *Journal*, is much to be deplored, and greatly calculated to retard their progress in this country. If, therefore, it is in my power to throw any new light on the subject, it is only false delicacy to hold back. In discussing the question "Are so-called regenerative retort-furnaces a failure?" I must ask your indulgence, as it will be necessary to go over some of the old ground, although, I venture to think, not without advantage.

Cicero says: "It is the first law of history that the writer should neither dare to advance what is false, nor to suppress what is true; that he should relate the facts with strict impartiality, free from ill-will or favor; that his narrative should distinguish the order of time, and, where necessary, give the description of places; and in his account of the transactions and the events interpose his own judgment; and should not relate what was done, but how it was done, and what share chance, or rashness, or prudence had in the issue." This formula, written many centuries ago with a different application, appears to apply with singular directness to the present inquiry. It is not meant to charge the *Journal* with having advanced what is false or suppressed what is true, or with having shown partiality in relating the facts; but I do think that, in asserting that "the problem of gaseous firing, as it was stated" by Mr. Valon "in 1884, has been almost wholly solved in 1885," and that "the verdict of experience is against the hyper-elaboration of regenerators," the Editor has, in his account of the transactions and the events, interposed his own judgment without having related all that was done or how it was done, or what share chance, or rashness, or prudence had in the "small success and much trouble" which attended the systems "sporadically tried in different parts of the country," and on the evidence of which the whole class is summarily condemned. To some of the gas engineers in the Midland Counties, and doubtless elsewhere also, who for some years past have been, and still are working intelligently with regenerative furnaces on the German and allied models, or, as they have been facetiously termed "hyper-elaborate" systems, it caused no small astonishment to be assured on such a high authority that they had "been almost driven out of the country," and that "it was their own inherent weakness" which had killed them; whereas we were not only actually working them in considerable numbers at the time, but our experience had taught us conclusively that their so-called complicated construction, instead of being a source of weakness, was their chief merit, and, besides being thoroughly scientific, such forms of construction were found to be absolutely necessary to achieve the maximum of commercial economy. On these grounds I am prepared to maintain that the problem of gaseous firing, as it was stated by Mr. Valon in 1884, has not "been almost wholly solved in 1885" in the sense indicated.

What was the problem of gaseous firing as stated by Mr. Valon in the

paper he read before the Institute in 1884? Shortly, this: That with a proper generator furnace it is unnecessary to have a multiplicity of channels in the regenerative flues, owing to the small amount of legitimate heat in the waste gases, and the readiness with which it is given up to the secondary air supply. In support of this he instanced his working with *his* generator and regenerative furnaces side by side; showing that the utmost practical advantage of the regenerative process was a saving of a little more than 2 lbs. of coke per 100 lbs. of coal carbonized. I think this fairly and fully states Mr. Valon's position. I have made no mention of the hypothesis which was advanced in reference to the heating of air, because this was withdrawn in an article which afterwards appeared in the *Journal;* but he then reasserted his claim to have proved that there is no need for what are termed elaborate regenerators, although not apparently on the ground that the available waste heat is insufficient to raise the secondary air supply to what he calls the desired temperature, but that whatever heat there is at disposal is so readily absorbed that it is unnecessary to adopt anything but the simplest means for the purpose, and that his furnace fully accomplishes all that is possible. It may be said, therefore, that the controversy between simple and elaborate regenerators—or, more correctly, between *partial* and *complete* regeneration—turns mainly on the question of economy of fuel.

Now, if it can be shown that with some other form of regenerative furnace the coal in the retorts can be carbonized at a much less expenditure of fuel than is required by Mr. Valon, it is not unreasonable to suspect that his thesis is wrong; and strong grounds exist for asking if it is "proved clearly that the legitimate waste heat of the setting is not sufficient to raise the air to the desired temperature without assistance," and for doubting whether the problem of gaseous firing was solved in 1884, because the other elements—namely, the economy of construction in relation to economy of working, and the durability and general practicability of the higher types of furnaces—are all matters that must be determined in the light of proper experience; and it will not do to condemn the elaborate furnaces in an off-hand way, as has been done, simply because of some insignificant failures in different parts of the country, not only to the injury of inventors who have spent both money and brains in working at and perfecting them, and who have a right to their reward, but probably also to the discomfiture of those of us who, undeterred by prejudice on the one hand or prompted by partiality on the other, are trying by all the means in our power to get at the best and cheapest furnace for the benefit of those whose interests are largely committed to our keeping.

Now let us bring the matter to the test of practical working; and as an illustration I will take a period from the carbonizing-book—namely, from the 1st to the 10th of April last—during which time the whole of the gas was made in five settings of 16 ⏀ retorts each, or 80 retorts 9 ft. 6 in. long and 24 in. by 14 in., heated by Klönne's furnaces. It was not in the knowledge of anyone (myself not excepted) that the working of these days would be made use of for this purpose. I have chosen it, not because it is a specially good example of working, but simply on account of its being a period during which there were no disturbing elements introduced. The coal was weighed into the retort-house at 20 cwt. to the ton. The results are shown in the table before you, placed side by side with the figures given by Mr. Valon in 1882 from the working of his generator furnace, and those of 1884 (as far as he gave them) from the working of his regenerator furnace; chaldrons of 13 cwt. being reduced to tons:—

	W. A. Valon, 1882.	W. A. Valon, 1884.	R. O. Paterson, 1886.
1. Coal used	5507.00 tons.	.....	629.50 tons.
2. Coke made, at 13 cwt. to the ton	3579.55 tons.	.....	409.17 tons.
3. Coke sold	3050.45 tons.	.....	382.86 tons.
4. Coke used for fuel	529.10 tons.	.....	26.31 tons.
5. Coke used, per cent. on make	14.78 p. c.	.....	6.43 p c.
6. Weight of fuel used per cwt. of coal carbonized, assuming each ton to have produced 13 cwt. of coke	10.76 lbs.	.....	4.68 lbs.
7. Weight of fuel used per 100 lbs. of coal carbonized	.....	12.3 lbs.	4.18 lbs.
8. Gas made per ton of coal	10,575 c.ft.	10,016 c. ft.	10,545 c.ft.
9. Make per mouthpiece per day	.....	8,000 c. ft.	8,297 c.ft.

According to this table, it will be seen that Klönne's furnaces use only 4.18 lbs. of fuel per 100 lbs. of coal carbonized, against 12.3 lbs. as used by Mr. Valon in his regenerator furnace; being a saving in favor of the Klönne of 8.12 lbs. of fuel for every 100 lbs. of coal carbonized. The elaborate regenerator, therefore, only uses a little more than one-third of the fuel of Mr. Valon's simple regenerator, based on his own method of calculating the fuel account on the difference between the coke sold and a production of 13 cwt. from each ton of coal. Good as Mr. Valon's furnace is compared with the old system of direct firing, it uses just 194 per cent. more fuel than Herr Klönne's. Although I have been compelled to accept the method of calculation used by Mr. Valon in ascertaining his fuel account for the purpose of comparison, I do not consider it a correct one. It is necessary to say this because I wish to guard myself against being credited with a fuel account of only 4.18 lbs. of coke per 100 lbs. of coal. The error lies in subtracting the actual sales from an assumed production, and debiting the difference as fuel. In the case of South Yorkshire coal, which we used, there is known, by experiment with thoroughly worked-off charges, to be just 13 cwt. of coke to the ton of coal weighed without quenching; but it is evident that if the whole of the coke from a ton of coal were drawn out into the yard, quenched, and sold, something more than 13 cwt. would be found to have passed over the weigh-bridge.

Though, in reality, both Mr. Valon's fuel account and my own are higher than is shown in the table, the comparison remains substantially correct, assuming that Pelaw Main coal yields not more than 13 cwt. of coke to the ton—and certainly there is not less. But this fact is ascertained without any doubt—that at Cheltenham Klönne's model of furnaces sends into the yard for sale 12.17 cwt. of coke per ton of coal carbonized, whereas Mr. Valon's furnace sends only 11.08 cwt.; being a difference of 1.09 cwt. per ton of coal used in favor of Klönne—a result which must demand consideration.

A great deal has been said and written against the Klonne and other types of German regenerative furnaces, on the ground of being complicated, difficult to manipulate, and lacking the necessary elements of durability. They are scientific in construction, and can scarcely avoid being what one must, in courtesy, call "elaborate," though not unnecessarily so to answer their purpose, and in my judgment not more elaborate although, as I have shown in the case of Herr. Klonne's furnace, they are more efficient than Mr. Valon's so-called "simple" regenerator. This elaboration, however, does not involve any difficulty in manipulating them, or render them less durable than so-called "simple" regenerators. The true test in a matter of this kind is experience; and I will proceed to relate the history of the first furnace erected in Cheltenham.

In 1882 a double bench of 16 ⏀ retorts, 24 in. by 14 in. and 9 ft. 6 in. long, set back to back, was erected. After carefully drying and heating, we charged the retorts on the 1st of May, 1883. From that day, with only a few slight interruptions (of which I will speak presently), until the 11th of June in the following year, or 395 days of actual work, a total of 5,366 tons of coal were carbonized; being 335 tons per retort. This trial was considered so satisfactory that it was determined to erect five other similar settings; and consequently the fire had to be let out to enable the work to proceed. After such a long period of continuous work, it was found on examination that the only repairs required were a 4½-inch lining of fire-brick in the two sides of the furnace, and the cleaning of the waste-gas flues with a housemaid's hand-brush. On the 15th of December, 1884, after the completion of the other five settings, the original bench was started again; and after having been under fire for 15 months, it was let down on the 21st of March last, having been charged 336 days, and carbonized 4,382 tons of coal, equal to 274 tons per retort. Thus making a grand total of 731 days of working, and 9,748 tons of coal carbonized; being equal to 609 tons per retort. From a careful examination which has recently been made, it is found that with another 4½-inch brick lining to the furnace, the cleaning of the flues with a brush, and the pointing of the retorts, the bench will be ready for work again next season; and, to all appearance, the furnace and regenerative flues are as good and as like working now as on the 1st of May, 1883, when it was first started. No inventor need be ashamed of such a record as this, and it goes a long way both to remove the stigma which has been cast upon this type of furnace—namely, that its construction is synonymous with "inherent weakness"—and to disprove the assertion that "the verdict of experience is against the hyper-elaboration of regenerators;" for if any of the furnaces in operation in this country can be called "hyper-elaborate," it is the one of which the working is recorded here, nevertheless it has successfully stood the test of prolonged use, and by its results proved itself superior to all the forms of so-called "simple" regenerators. What has been done by this furnace may be done by all; and the practicability of working successfully with elaborate regenerator furnaces is a fact demonstrated beyond the shadow of a doubt.

It may be asked, Are there no difficulties to be met with? Is it nothing but plain sailing? The only difficulty, if such it could be called, which I met with, arose from the perfection of the furnace combined with the recklessness of the German stoker at our first start. I must confess that had this workman continued his operations for 12 hours longer, the words "burnt down" would have expressively told the whole tale—but from no fault of the furnace. One of two things, or the two combined, is clear—either that the fireclay goods of Germany are more refractory under intense heat than those of this country, or else German coal is more easily carbonized than English; for to work off a ton of English gas coal per 24 hours in a retort 24 in. by 14 in., by 9 ft 6 in. long, as the German stoker attempted to do, requires a temperature in the bench such as no English fireclay goods,

as used in this country, can withstand. These high heats naturally brought about the inevitable accompaniment of stopped pipes and pitched-up mains. But, mainly by reducing the weight of coal and regulating the consumption of fuel, every difficulty disappeared; and in less than two months from the time of starting the working of this trial bench gave no trouble whatever, and it became the pet of the stokers. With the other five benches subsequently erected and now in use there has never been the slightest trouble, either with the furnaces, from stopped pipes or mains, or from any other cause. At first starting care was taken to regulate the size of the carbonic oxide nostrils to prevent local heating, which is easily accomplished by placing loose bricks upon them; and when once done the furnaces will run for six to eight months of continuous work without further attention. The ordinary method of looking into a retort, to judge of the regularity or degree of heat, is apt to be misleading in the case of regenerator furnaces; for, except when there is very great irregularity in the bench itself, the retorts do not show it, nor can any idea be formed of the heat of the bench in this way. It is, therefore, best to have a couple of sight-holes in the front wall, about the level of the middle retorts, for the purpose of inspection. It is probably to the neglect of this precaution, coupled with the effort to get an extraordinary yield of gas per mouthpiece, that most of the reported failures are to be attributed.

The cost of constructing Klonne's furnaces (and I suppose all others of the German type) is considerably greater than that of the simpler forms. Mr. Valon puts his furnace at £45, or upwards of £6 8s. per mouthpiece. The furnaces referred to in this paper cost £160, or £10 per mouthpiece, although no doubt they could be erected for less now, as there was a conscious aim to err on the safe side in the strength and quality of material used. But taking the cost at £4 per mouthpiece more than Mr. Valon's, it is not difficult to show that it is money well spent. Taking the coal carbonized up to the present time in the furnace, the history of which is recorded here, as 9,748 tons, the extra saving of coke alone amounts to 531 tons; and reckoning it at the low value of 6s. 8d. per ton, there has been a corresponding saving of £177 for an additional first cost of £64, or, say, 4½d. on every ton of coal carbonized. In other words, the whole of the extra cost of construction is entirely neutralized by the saving in fuel in the first 271 days of working, with the selling price of coke at 6s. 8d. per ton. The small cost of furnace bars may be confidently considered as balanced by the cost of the supply of steam required by Mr. Valon's furnace.

I have thus endeavored to prove that so-called "elaborate" regenerative retort furnaces are not a failure. Although they are more costly to erect than the simple forms of which Mr. Valon's is the prototype, they are more economical in respect of fuel; and further, experience has proved their durable qualities, and demonstrated the fact that, in the hands of the practical gas maker, they do not present any difficulties in working.

It may be asked, how is it that the elaborate regenerator accomplishes such a saving of fuel, seeing that, as Mr. Valon stated, in 1884, the secondary air in his furnaces absorbs as much heat as can practically be taken from the discharge flues; proving at the same time, on theoretical grounds, that it was not possible to get much more saving in this direction? As Mr. Foulis said, "an ounce of practice is worth a pound of theory;" and as it is a fact that Mr. Valon's furnace uses 194 per cent. more fuel than another form of furnace, his theory must be pronounced fallacious, and consequently the furnace constructed upon it stands condemned also, for it must be evident that the additional saving in fuel can only be the result of a more perfect utilization of the legitimate waste heat in the exit furnace gases. I am convinced that between simple and elaborate furnaces there is just the difference between an elementary and a highly perfected design.

It will be understood that there is no personal feeling of hostility in this question. My task has not been a congenial one; but, however unpleasant it may have been, I hope it will help, in some degree, to remove the reproach which at present rests upon the gas engineers of this country, of being less scientific in their practice than their brethren on the Continent. It only remains to be said that I have no pecuniary or other interest in any furnace whatsoever; neither have I patent rights in any eccentric shape of brick or other material of any kind or form in connection with them.

North British Association of Gas Managers.

At the last annual meeting of the North British Association of Gas Managers, held at Edinburgh, Scotland, on July 24, the proceedings were of more than ordinary interest. We reprint the two following papers, in the belief that their contents will be of interest to those operating small plants in this country. The first was contributed by Mr. J. Turnbull, of Lauder, and it discusses

THE GENERATOR FURNACE IN SMALL GAS WORKS.

The regenerator furnace and the scientific principles on which it is based have frequently been brought before the members of this Association, and the application of it in various forms to the heating of retorts for the manufacture of coal gas is an accomplished fact; yet it has been adopted to a very limited extent, more especially in small gas works. There is no reason why this should be so, as, were the system properly applied and attended to, it would tend greatly to assist the managers of small gas works to make ends meet in these dull times when the revenue from residual products has nearly reached the vanishing point. A generator furnace of a very simple construction for heating an oven with one retort has been in operation at the Lauder gas works for the past three years, and I have been requested by your Secretary to give a short description of it.

The diagram shows settings built in a similar way to those at work in Lauder. You will observe that the furnace is constructed to be as large and deep as possible, and with the usual furnace bars, the primary air ascending through the fuel in the ordinary way. The secondary air supply is obtained by placing a 6-inch glazed tile pipe through the back flue, along the floor and toward the front of the oven, where the air meets the gases from the furnace. The retort is supported on cross-walls, the back one being carried up so that the heat, after passing all round the retort, may not descend directly to the main flue. In front of the oven is a pit 4 feet square by 4 feet deep, to give access for cleaning, a water trough being formed by a brick on edge laid in cement across the front under the furnace. The pit is covered with plain and grated plates, allowing a supply of air to pass under the fire-bars. The plates are laid loose, so as to fold back when the furnace requires clinkering and cleaning, which is done once a day or oftener, depending on the coke used. The furnace requires very little attention; the secondary air supply only requiring to be regulated from time to time, according to the rate at which carbonic oxide gas is produced. If too little air is supplied, the gases pass through the oven and into the main flue unconsumed; if too much air is allowed to enter, it tends to bring down the heat. But anyone of ordinary intelligence, after a little practice, can judge of the regulation required by merely looking in at the spy hole.

The retort is 13 inches diameter and 7 feet 6 inches long internally, and carbonized 1 to 1¼ cwt. of coal in 3½ to 4 hours, and the coke produced, which is drawn directly into the generator—this effects a great saving of heat—is sufficient to keep up the heat for 24 hours, although gas is only being made from 14 to 16 hours. The consumption of gas in Lauder is so small that in the summer months the quantity is not sufficient to keep one retort constantly at work. In the old setting the consumption of fuel was very high for the quantity of coal carbonized, and so, having occasion to renew the retort bench, I adopted the arrangement above described. This has been found to give very good results, and suits the circumstances in which we are placed.

I am sorry that I cannot give exact data as to the saving effected, but I can assure you it is very considerable. In the old arrangement of furnaces, when making four charges per day of about 1 cwt. each, all the coke produced, with the addition of 2 cwt. of coal, was required to keep up a fair working heat during the 24 hours. In the present arrangement the coke made from 4 cwt. of coal is sufficient to keep up a better and more regular heat during the 24 hours. I also find there is a great reserve of heat, which is under direct control; and this is found to be of considerable advantage. Another benefit arising from this system is that the retorts last much longer—how much longer I do not know; but a single retort is now working the fourth season, while formerly the retorts did not last more than two seasons. The present retort is of fire-clay, costing about 30s., those formerly in use having been of cast iron, and costing about 150s. The first cost of construction of the setting may be a little higher than the old style of furnace, but this will depend greatly on locality, a considerable portion of the cost in our case being railway carriage and cartage. I need not take up the time of the meeting further, as there are matters of greater importance to occupy the time.

Discussion.

Mr. Henderson, (Dysart)—This is just a modification of the plan of Mr. Watson, of Stirling. He read a paper on it at Stirling two years ago. I adopted the plan, and one or two others tried it, and we all had to discard it. I went to Stirling expressly to get the measurements, and saw how the air was led. I have three retorts in my oven, which are 9 feet long, 20 by 15. I could melt the bottom retorts, but I never could get a heat above blood-red in the upper retorts.

Mr. Burton, (Motherwell)—I visited Lauder, and saw Mr. Turnbull's retorts in the most excellent condition. Mr. Turnbull deserves the greatest credit for his enterprise in trying to bring about a new invention in a small place, where in summer they only need one retort. The invention is very simple. I don't suppose he has taken any patent for it. The furnace, Mr. Henderson speaks of must have been affected in some way, and I think if Mr. Henderson had paid any attention to some of the side flues he would have got the heat equally well at the top as at the bottom.

Mr. Henderson—It does not happen to have side flues.

Mr. Somerville, (London)—I had a ten days' fishing expedition on the

Leader last year, and I called and saw Mr. Turnbull's furnace. I have had some experience with these furnaces since 1878, and I was very much pleased to see how his ingenuity and perseverance have overcome difficulties. Here was a gentleman, in a little country town with one retort, who makes as much gas on the Monday morning as will last the week. He has actually constructed one of the most scientific appliances that I know, and there is no reason why gentlemen who have small works should not get the same results, and save 50 per cent. of their coke. Mr. Turnbull is worthy of every praise for the manner in which he has worked out the arrangement.

Mr. Robertson (Bathgate)—Mr. Turnbull says that the matter is not important, but I think it is all important to have something applied to small gas works. We know that they are the greater number, and I think it is a good thing when such a paper is read. I was under the impression that our works was the first small one that had started this regenerative principle, but I find that Mr. Turnbull has been before me. It is only a year since we adopted a system of regenerative furnaces patented by Mr. Hislop, and I am pleased to say that it has been successful. The saving of fuel is something like 30 per cent. With regard to the ascension pipes, I have never found in our works any more choked pipes with this system than under the former.

Mr. Watson (Stirling)—I have never said, at any time, that the system I was working with was regenerative, but only an improvement in combustion. We have at present ten retorts with two furnaces, and the best answer for any sceptical individual is, "Come and see them working for yourself." They are working now with a large saving of coke.

Mr. Turnbull, in reply, said: I thank you very much for the kindly spirit in which you have received the few remarks I had to make. With regard to Mr. Henderson's remarks, I may state that I have likewise a furnace on the same principle heating two retorts, which is all we require, and I have found no difficulty, the heat being equally diffused all over the oven. The whole thing is just a simple single brick put a little on the top of the oven to prevent the heat coming too quickly into the flue. There is a small amount of regeneration, because the six-inch pipe through which the secondary air is supplied comes through this main flue, and is kept at the red heat by means of the gases that have left the oven. Sometimes I have to use coal, and the results are not so good with cold coal thrown into the furnace as with the hot coke drawn direct from the retort. The hotter the furnace is the better for the gas. There is only one thing that has not been shown in the diagram, and it is that the primary air supply requires to be regulated below, which I accomplish by means of a sheet iron door set up under the bars in front of the pit. I would not now return to the old style of furnace upon any consideration. The new is so much easier to work, and answers every requirement in a small way so much better.

The second paper was read by Mr. James McNair, of Renfrew, who treated the convention to some remarks on the matter of—

REGENERATIVE FURNACES AS ADAPTED FOR MODERATE-SIZED GAS WORKS.

I am sorry that the time at my disposal has been so short since finishing this model, representing an oven of 5 retorts on a regenerative principle, adapted for moderate-sized gas works, that I have been unable to get up a paper of any great interest to men of such scientific attainments as those now before me.

It is thought by many at the present time that heating retorts on the regenerative principle in large gas works is a thing which cannot be attained with any profitable results, and, therefore, it is at once concluded as a thing out of the question to expect profitable results when applying the principle to small or moderate-sized works. But, gentlemen, I have found when experimenting with an oven with one retort, in the gas works at Holytown, on a system which has been lately patented by me, and also a trial made on the principle at Barrhead Gas Works, then under the management of Mr. Fairweather, extending over the whole of last season, that firing on the regenerative principle may not only be successful in a large works, but also in those which are small or of a moderate size. Even in a works which is only capable of keeping one retort going the principle may be profitably applied, as I hope I may be able to show clearly in this paper.

Having obtained the consent of my directors in Holytown, I started with an oven of one retort, measuring 12 inches by 14 inches, by 7 feet 4 inches. I cut part of the back wall of the oven near to the upright flue; then lifting four courses of the bricks out of the sole of the oven, I laid a 5-inch fireclay pipe from the top of the bench down alongside the main flue, then along the sole of the oven and back behind the original furnace—the furnace itself being made V-shaped, with an open space at the bottom about 1½ or 2 inches. I then built up two half arches, forming the producer and air channel. Not having a boiler for the purpose of generating steam, I had to use water in the following way: In and around the bottom of the producer I laid a ¾-inch iron pipe perforated so as to allow the water to spurt in amongst the coke.

With this rather crude apparatus I was in a position to begin experimenting. Putting into the producer the product of 2½ cwts. of coal in hot coke, I turned on the water, and the producer was at once in a fair working order. This would be about 12 o'clock noon, and, being a small works, I was obliged to damp down at 9 P.M. for the night, and the next morning by 8 o'clock I had the producer in working order again. When the time arrived for damping down for the night I had a good working heat on, so that I had it actually working 22 hours with an interval of 11 hours after the first nine, and during this time I did not require to charge the producer oftener than every four or five hours, and the amount of coke required was always the same—namely, from 1¼ to 1½ cwts. I observed that the refuse or ash was of a soft nature, and clinkers were not formed at any time. The amount of ash from the producer did not exceed four shovelsful during the whole time it was at work. I may be asked why I did not continue my experiments longer. The reason was that I was unable to keep a retort in full work at the time, and also because the amount of storage I had was so great in proportion to the make in that season that I could stop making gas for two or three days at a time, and, therefore, I could not get enough hot coke to keep it going.

From the success I obtained in my experiments I have no hesitation in saying, that should a system of this description be adopted, even in the smallest works, where only one retort is kept in action, it would not only be a saving in time to the man in charge, but seeing that the amount of fuel that must be bought in for works of this size is very considerable, and as the product of one retort is quite sufficient to keep the producer in motion, the whole of this expenditure would be saved, and a considerable addition of profits would thereby accrue to the company.

With reference to the oven of five retorts, which were built in at Barrhead, and left under the guidance of Mr. Fairweather, the producer did not reach below the level of the floor and was rather narrow, so that it could only hold about half the charge of the upper retort; and, therefore, it was necessary to charge the producer every two hours instead of every four; and, under the arrangement of the flues, the two under retorts did not heat so well as was expected, but the two second and the top one were all that we desired—in fact the top retort kept so good heat that it could be charged with 2½ or 3 cwts. every three hours. But even with these disadvantages, Mr. Fairweather found that in the month of October he had 20 tons more coke than he had in the same month of any previous year; and as coke was being sold at 5s. per ton, this represented a saving of £5 for the month, or £1 per mouthpiece. To get rid of these disadvantages I have found it advisable to lower the producer 14 inches below the level of the floor, and adopt another system of flues, which is embodied in the model now before you, and under this arrangement I am certain it will give every satisfaction, even although a greater number of retorts are in the oven.

In speaking of the advantages to be derived from working on this system, as compared with some of the principal systems now in use, I may mention, first, that there is no staging whatever required; second, no sinking is required for ovens of one, two, or three retorts, as the producer can be put in at the floor level; that this system can be applied to ovens built on the old principle, by merely cutting out the back wall to allow the air tubes to be put in; and once in they never require to be renewed as long as the bench or oven keeps in a working condition. When renewing retorts all that is required is the building up of the two half arches; fourth, with reference to the cost of building an oven of five retorts on this system and on the old principle, I may say that this plan will cost about £12 more than the old one, but this includes the cost of putting in the air piping, which, as I said before, never needs renewing. When renewing the retorts on this system the cost for an oven of five retorts, is about £2 10s. to £3 more than an oven of the same number of retorts on the old system, or from 10s. to 12s. per mouthpiece; and, allowing a retort to last two years, this means a cost of from fivepence to sixpence per mouthpiece per month extra.

Discussion.

Mr. M'Nair, in reply to a question, said: The retort did not heat so well as I wished, so that I made the alterations in the flues which are embodied in the model now before the meeting.

The Chairman, finding little disposition on the part of the meeting to discuss the question, said: Personally I would be very sorry if we had no discussion. It is a very interesting subject, and one of the highest importance to gas managers, by whom it ought to be thoroughly well known. There has been great experience and great expenditure of capital upon the same broad principle of regenerative firing. Now that we have got something simpler I think it is the duty of the members present to express their opinions, or ask questions, so that we may arrive at a fair estimate of Mr. M'Nair's invention.

Mr. J. Hall (St. Andrews)—I think there is no doubt that the great expense of regenerative furnaces has kept many managers of small works from adopting them. I think this invention is in the right line. However, I should like to ask Mr. M'Nair if he finds that these five retorts are equally heated in the position they occupy?

Mr. M'Nair—I have no hesitation in saying that all the retorts will be equally heated.

Mr. Hall—My first impression was that they would not. I should have thought that the two lower retorts would not heat nearly so well as the next two and the top one. I think that the plan of our Lander friend is a much more practical one, the position of the furnace being more down, so that the whole heat goes to the retorts, especially to the bottom ones. Of course, I am speaking from theory, not from practice.

Mr. J. Somerville (London)—I can only say that I am glad to see that it is a step in the right direction, and that we must come to it eventually. I go in for moderate, not elaborate, regeneration. I have built a good many furnaces throughout England something similar. The difference is that my regenerating pipes are lower down, and they are 9 inch by 3 inch. I found the retort was better heated by having flat pipes placed in the bottom flue. To my mind there is a little difficulty about the two bottom retorts being heated. I think the zone of combustion is a little bit higher. The tops and center would be all right, and I think that after this gentleman has had more experience he will find he will have to lower his furnace about two feet. My friends are, however, on the right line, and we shall all have to come to it, depend upon it.

A Member—I understand Mr. M'Nair has had some experience with this furnace. I think, so far as I can gather from the opinion of managers of smaller works, their greatest difficulty is with regard to the durability of the understructure of these settings, as to their lasting the full life of the retort. In the smaller ones we have a greater chance of cooling and resetting the settings. Possibly he may give us his experience in this matter.

Mr. David Terrace—I may state I devoted some little attention to the subject in its adaptation to moderate-sized gas works, and this drawing and the model seem to go directly on the same lines on which I did some little drawings. Although it is not original, I do not say it is not good. I think it is the very line which ought to be adopted in taking the full value from the coke. I have no experience of these settings, but they are almost what would suggest themselves to anyone who studies the subject. Putting in tile pipes seems to be a notion that I do not fancy. I do not know what advantages there are in the tile pipes.

Mr. M'Nair—With reference to the tile pipes, my experience was that in building flues with brickwork there were a vast number of contractions which caused open spaces, and the hot air, taking the nearest course, would pass away. That was my idea for taking to the tiles, because in the three feet there would not be so many crevices through which the air might pass. As to the heating, in the front portion of the retorts there is a chamber so that the heat has to go down to the bottom retort at the very beginning, and then make its way through the others. The whole force of the heat must go to the bottom. In the first furnace the bottom retort did not heat well, but this improvement put matters right. As to durability, there was no difference from the old system. There is no waste.

Mr. Hall—Did you not find that the top retort heated much more than the others in your first structure?

Mr. M'Nair—Oh, yes; but it heated equal to the two second.

Mr. Hall—That was what made me think that if your furnace had been lower your oven would have been a greater success.

Mr. M'Nair—My idea is not to lower it.

A Member—Has that ever been in use at all—the system as shown in the model?

Mr. M'Nair—The system, with the exception of these alterations of the flues, has been used.

The Chairman—I regret very much that this paper has not brought forward a more animated discussion than it has done. It is a subject in which I have taken a very great interest, and although I have always held that the intricate and expensive settings of the regenerative furnaces were not what I thought ought to be in use for the accomplishment of some ends, yet I have not been able to bring forward a cheap system of regeneration where the saving is as great as by the elaborate settings. I have had three different settings at work, and as to the amount of work they did I had no reason to complain; but I must admit that the saving in the fuel was not what I expected. Therefore the intricate settings, so far as I have seen, seem to have the best of it. While saying so, I must also state a very simple form of regenerati n is carried on by Mr. Somerville at the Bankside works, and the quantity of coke used is very small indeed. If we could get at the same results I should say we were on the correct lines, but what experience I have had with this system of working has not led me to that result.

[It should be added that we are indebted to the *Gas World* for the above report.]

He must be a Dealer in Wooden Nutmegs.—The Boston *Journal* is authority for the statement that "a Hartford man circumvents the gas company by storing his meter in a safe deposit vault when he goes off for the summer." Possibly that particular "Hartford man" thought he had better leave something in a "safe" place which he had made bare prior to taking a suspiciously sudden trip to Canada.

The Kitchen-Cabinet Investigators' Gas Bill.

In the Senate of the United States, on July 7th, 1886, Mr. Spooner, from the Committee on the District of Columbia, submitted a report (No. 1460), accompanied by the following bill (which was read the first and second times by unanimous consent), relating to the manufacture and sale of gas in the city of Washington, in the District of Columbia, and amendatory of an act entitled, "An act regulating gas works," approved June 23, 1874.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That the Washington Gas Light Company is authorized to charge and collect, after the passage of this act, for illuminating gas furnished to and paid for by the Government of the United States, and other consumers in the city of Washington, at the rate of one dollar per thousand cubic feet: *Provided*, That if consumers other than the Government shall not pay monthly any gas bill within ten days after the same shall have been presented, said company may charge and collect from said consumer so failing to pay said bill as aforesaid one dollar and twenty-five cents per thousand cubic feet for the gas furnished to said consumer during said month.

Sec. 2.—That it shall be the duty of the Secretary of War, within thirty days after the passage of this act, to appoint a board of three competent and disinterested persons, whose duty it shall be, after having been first duly sworn, to investigate—

First—The character of gas usually furnished in the city of Washington by the Washington Gas Light Company, with especial reference to its healthfulness to consumers; whether it would be better for the public health that the gas furnished should be entirely coal gas, or entirely water gas, or if a mixture of the two is admissible, in what proportions the same should be combined; and also whether the gas so furnished complies with the requirements of the law as to illuminating power.

Second—The general subject of gas manufacture and the methods and processes which produce the best gas for common use, regard being had to the health of the consumers, illuminating power, and economy; the cost per thousand cubic feet at which such gas can be manufactured and distributed in the city of Washington, with estimates of the cost of the requisite plant for such manufacture; whether it is expedient for the Government to manufacture and furnish gas for its own use and for the use of consumers in said city; whether the gas plant now in existence in said city is adapted to the manufacture of such gas, and the fair value of the same, and what the cost would be of duplicating the same, or so much thereof as might be necessary.

Third—The actual fair cost per thousand cubic feet to the Washington Gas Light Company of the gas manufactured by it and furnished to the Government and to other consumers in the city of Washington, or of such gas as said board shall find should be furnished by said company under the law.

Fourth—The best system of gas inspection, and the best method of protecting consumers against unfair measurement of gas furnished, and against violations of law as to the purity and healthfulness of gas; whether a reduction of the price of gas in the city of Washington has been followed by a corresponding reduction in the bills of consumers, and whether any method is or has been in use in said city whereby illuminating gas not furnished has been charged for.

Fifth—Such information upon the general subject in its relation to the interests, hygienic and otherwise, of consumers in the city of Washington, and in its relation to the interest of the Government, as shall be indicated by the Secretary of War from time to time, pending the investigation by said board. The said board shall report to the Secretary of War, as soon as may be after its appointment, and not later than the first day of the next session of Congress, its conclusions, and the testimony and reasons upon which the same are founded, as to the healthfulness of the gas furnished to consumers in the city of Washington, and as to its illuminating power, and wherein the same should be changed, if at all, in either respect; and the said Secretary of War shall immediately notify said gas company of the conclusions of said board, if he shall approve the said conclusions; and the said gas company shall conform the gas furnished to the requirements of said board, and shall continue so to do until Congress shall otherwise by law direct. The members of said board shall each be entitled to compensation at the rate of ten dollars per day for each day actually employed under the provisions of this act; and, in addition, all expenses necessarily incurred while actually performing such duties; but no payments shall be made to said members as compensation, or on account of the expenses of said board, until the accounts and vouchers therefor shall have been first examined and approved by the Secretary of War.

Sec. 3.—That if, pending the investigation by this act directed, or if, at any time, the Washington Gas Light Company shall represent to the Secretary of War, under the oaths of its president and directors, that the said company cannot, by reason of increase in the cost of coal, or of labor, or of

other expenses entering into the cost and distribution of gas, or for any cause not produced by or the fault of said company, with due economy, earn, at the rate per thousand cubic feet for gas by this act authorized to be charged, the sum of seven percentum per annum net upon its capital stock of two million dollars, the said board, if not dissolved, or if dissolved, a similar board to be appointed by said Secretary for the purpose, shall, upon the order of said Secretary, make investigation into the affairs of said company, the actual fair cost to said company of manufacturing gas per thousand cubic feet, and into all such matters touching the management, expenditures, and government of said corporation as to the said board shall seem proper in the premises; and the said board shall report its conclusions upon the subject, and all evidence taken by it or laid before it, to the said Secretary of War; and if the said Secretary shall be of the opinion, upon a review of said report and evidence, that the said company cannot, with due economy and honest and skillful management, earn upon its said capital at the said rates a net dividend of seven per centum per annum, he shall, with the approval of the President of the United States, issue to said company a license or permit to charge per thousand cubic feet such sum, to be indicated in said license or permit, as will, in his opinion, enable said company to earn said seven per centum dividend; and said company may thereafter charge the consumers of gas in said District, including the United States, the sum named in said license or permit, and consumers, other than the Government, who shall fail to pay, as aforesaid, twenty-five cents per thousand cubic feet in addition as aforesaid, until the said rate shall be changed by or under the authority of Congress. The said board, and every board appointed by the Secretary of War under the provisions of this act, shall have power to send for persons and papers, and to administer oaths to witnesses, and to examine and cause to be examined the books, records, and papers of said gas company, and may employ a stenographer, and, with the approval of said Secretary first had, may employ such gas experts and accountants to assist them as shall be necessary, and the said board may, upon request to the Attorney-General, approved by the said Secretary of War, have counsel furnished them to aid in conducting said investigation. All reports made by said board shall be in writing; and the said reports, together with all evidence taken by said board or laid before said board, and all action taken under the provisions of this act by the said Secretary of War, shall be laid before Congress at its next session. From and after the passage of this act all statements now required by law to be furnished by said gas company to the Secretary of the Interior shall be furnished to the said Secretary of War, and the inspection of gas and gas meters in said city shall be under the supervision of said Secretary.

SEC. 4.—That this act may be amended or repealed at any time, and the rates hereby fixed, or which shall be fixed under the provisions of this act, shall be subject to be abrogated or modified by Congress at its pleasure.

SEC. 5.—That all acts and parts of acts contravening the provisions of this act are hereby repealed.

The Opinion of Attorney General O'Brien.

On the 26th of July the Attorney General of the State of New York handed down the following opinion as the result of his study of the arguments heard by him last June, when the attorneys for the Gas Consumers' Association of this city sought to have the State bring suit for the annulment of the charter of the Consolidated Gas Light Company, the prayer for which was based on the ground that the consolidation proceedings were unlawfully carried out. Perhaps Sherwood might do well to have his attorneys "read up their books"—certainly the Attorney General's opinion will not go far toward causing them any self-gratulation. The Attorney General, having quoted sections of the statute under which the consolidation was effected, goes on to say:

"It will be seen that under the first section of this statute the total capital stock of the corporation permitted to be formed thereunder by consolidation is not limited to the aggregate capital of the constituent companies, but the contracting parties were at liberty to fix the capital of the new company at any sum not exceeding the fair aggregate value of the property, franchises, and rights of the several companies to be consolidated. The Consolidated Gas Company is the product of this statute. The New York, the Manhattan, the Metropolitan, the Municipal, the Knickerbocker, and the Harlem Gas Companies, by their trustees and directors, agreed to consolidate. The agreement was submitted to the stockholders of each of these companies, by them approved and ratified, and the papers filed, as required by the statute, in the office of the Clerk of the county and city of New York, and in the office of the Secretary of State. The capital fixed for the new company was $30,076,000, and it is claimed that this sum was far in excess of the fair aggregate value of the property, franchises, and rights of the several companies absorbed in the consolidation, and therefore the statute has been evaded or violated, and hence no valid incorporation was ever effected. If this position be correct, and nothing was accomplished by the attempt to consolidate under the act of 1884, it would seem to follow that the separate original companies were not affected by this invalid proceeding, and that they are still existing as valid corporations.

"But I cannot concur in the proposition that an excessive valuation placed upon the property, franchises, and rights of the several companies proposing to enter into the consolidation would invalidate the proceedings and defeat the attempt to form a new corporation. It is quite likely that this statute was too liberal and lax in those provisions which permitted the capital of the new corporation to be based upon the value of the property, franchises, and rights of the old companies, instead of basing it upon the aggregate capital which they possessed at the time of the consolidation. The statute doubtless afforded means for the formation of manufacturing corporations by consolidation with an excessive capital, and in the case of gas companies this excessive or nominal capital was made the basis for exorbitant, or at least excessive, prices for gas. But the whole matter was clearly within the power and discretion of the Legislature, and, acting within this power and discretion, it authorized the trustees of the several companies intending to consolidate to enter into an agreement which should specify, among other things, the capital stock of the new company, limiting its capital to the value of the property, rights, and franchises of the several companies entering into the agreement.

"The Legislature thus in effect delegated to the trustees of the constituent companies the power to fix the value of the franchises, rights, and property of the several companies which should form the capital of the new corporation. In arriving at this value they were necessarily called upon to exercise judgment and discretion. It became their duty to estimate and fix the value of the property possessed by the several companies, and, in my opinion, unless they acted corruptly or fraudulently in fixing this value, their proceedings could not be held invalid because they erroneously fixed an excessive valuation. The value of the property and rights of the old companies was essentially a question of fact. It had to be settled and decided in some form and by some authority. The Legislature, whether wisely or otherwise it is not now important to inquire, delegated this power to the trustees, and required them to specify the capital of the new company, which should not be in excess of the property of the old ones.

"It seems to be a reasonable and fair construction of the statute to hold that, in case the trustees of the several companies intending to consolidate acted honestly and in good faith, and placed a valuation upon the property, franchises, and rights which it was their duty to estimate and appraise, and thereby fix the capital of the new company, that the corporation thereby formed would not be subject to dissolution or destruction if it was subsequently ascertained or could be established that the trustees signing the agreement were mistaken in their estimate of value. It might be that either by judicial proceedings or by legislative action the capital of the new company could properly be reduced to the value of the property and rights of the old companies; but it would seem to be manifestly unjust to subject it to destruction under the circumstances.

"The action which I am requested to commence is substantially one in behalf of the people to try a question of fact—viz, whether the property, rights, and franchises of the six companies which entered into the consolidation was equal to the sum named as the capital stock of the new company. Such an action would necessarily have to be determined by the verdict of a jury, and its result would depend largely, indeed entirely, upon the opinion they should entertain in regard to the value of the property of the old companies, upon evidence consisting largely upon estimate and opinion.

"I am persuaded that such an action, even if it could be successfully prosecuted (which I very much doubt), would not subserve any public interest. It would cause much confusion and mischief without producing any good results whatever.

"The whole question touching the validity of the consolidation of these several corporations has been subjected to an exhaustive inquiry by the Legislature. Two committees of the Senate have given it careful consideration and thought, and the last Senate committee, in a report to the Legislature, dated February 20, 1886, reported that the sum fixed as the capital of the Consolidated Gas Company by the trustees and directors of the constituent companies did not exceed the fair average value of the property, franchises and rights consolidated in the new organization. This committee also deliberately reported that after examination they found nothing in the organization contrary to law, but that in fact the stock had been issued and circulated by virtue of the law; that about one-sixth part of it was held by innocent purchasers, and that if injustice had been done to the gas consumers of New York city it was done by the Legislature in passing the act in question. The committee, as I understand it, was unanimous in its recommendations, but no recommendation was made to the effect sought by this application.

"The whole matter was then in the hands of the Legislature. It had the undoubted right to make ample and sufficient redress for any wrong that had been committed in the creation of the new corporation. It could have annulled its charter or provided for any other proceeding against it that was

thought proper. The power which prescribes the formalities to be observed in creating a corporation is also able to dispense with these formalities. In any action brought in pursuance of this application to try the question whether the valuation fixed by the trustees upon the property, rights, and franchises of the old companies, which formed the capital stock of the new company, the people would be handicapped and embarrassed by the moral influence of a Legislative report in favor of the regularity and good faith of the proceedings on the part of the company. If a legislative committee, with power to send for persons and papers, power to examine witnesses, and to make full inquiry, could find nothing illegal or improper in the organization of the corporation in question, would the Attorney-General be likely to obtain any different verdict or result from a jury? I think not.

"There are other reasons which seem to me to require the denial of this application. It appears in the papers presented to me that the Consolidated Gas Company furnishes gas to more than 100,000 consumers; that the tax paid by it in the city of New York amounts to more than one-sixtieth of all the taxes paid in that city; that it owns and uses for the distribution of gas more than 700 miles of mains; that the amount of taxes paid upon its franchises to the Controller of the State exceeds $30,000; that more than 1,000 shareholders have subscribed and acquired shares of stock since the consolidation, amounting in the aggregate to 100,000 shares, representing $1,000,000. It furnishes gas, as I understand, for lighting the streets and public institutions of the city. An action by the Attorney-General, if proper at all, would necessarily have to be followed by an injunction restraining the business of the corporation and the appointment of a receiver; and I cannot believe that the public interests require any such proceeding on my part, especially after a thorough and exhaustive examination on the part of the Legislature, and a report to the effect that the company was regularly and legally formed.

"It also appears that, since the petition presented to me was verified, the Legislature, acting upon the report of its own committee, has passed an act to regulate the price of gas in the city of New York, and has fixed the limit at $1.25 per thousand cubic feet. So that the main grievance of the petitioners and the alleged wrongs sought to be redressed by the action asked for have, in great part at least, if not entirely, been remedied, and the Legislature has impliedly, if not expressly, ratified the consolidation of those companies, and is presumably satisfied with the continuance of the franchise conferred upon this corporation. If it be true, as claimed in behalf of this application, that the property, franchises, and rights of the constituent companies was overvalued, and that as a consequence the capital of the new or consolidated company was far in excess of the amount contemplated by the statute, the evil which would result from this violation or evasion of the law would be an excessive capital upon which to base dividends and exorbitant prices for gas. It seems to me that the legislation of last winter, by which the price is limited to $1.25 per thousand feet, has corrected this evil, and that inasmuch as the price of gas is now fixed and limited by law, it is not as important as it formerly was what the nominal capital of the corporation furnishing the gas is fixed at.

"This application is made in behalf of the New York Gas Consumers' Association, and I find among the papers submitted to me the following letter, addressed by the President of the association to the Governor of the State in May last, in reference to the Thomas and Reilly Gas Bills which were then under consideration:

"'New York, May 13.

"'Gov. Hill—Dear Sir:—I desire to thank you for making the Reilly and Thomas gas bills laws. These give us fair competition as between buyer and seller, and will fairly regulate the commerce in gas in this city. Your reasons for rejecting the Commission bill are weighty and no doubt founded on good law and sound reason.'

"It is apparent, I think, that the legislation enacted at the late session of the Legislature was intended to solve the gas question in the city of New York. The Thomas bill provided a general law for the incorporation and management of gas companies in New York city. This bill enables new companies to freely organize and remove any unnecessary restrictions and hindrances which have heretofore prevented competition in the manufacture of gas. In the language of the Governor, 'It will effectually destroy whatever monopoly has existed in this business in the past, and cannot help proving beneficial to the people.'

"After full investigation by the Legislature of the affairs of the incorporation in question, and of the manner of its creation, and after the passage of the two bills in question, the one providing for the formation of new corporations, and the other regulating the price of gas, I cannot believe that any great public necessity requires the Attorney-General in the name of the people to bring an action against this corporation of so difficult and doubtful a character as the one contemplated by this application. I am not satisfied that such an action could be maintained, and even if it could, no public interests can be promoted by enjoining the operations of this corporation, affecting, as it evidently does, so many interests, and the appointment of a receiver thereof. Learned counsel who presented this application to me have argued with great earnestness and ability in support of such a course upon my part. I have therefore given the question careful and deliberate consideration, and have arrived at the conclusion that the application should be denied."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Creosote as an Assistant to the Physician.—H. J. Fox, M.D., in an article communicated to the May (1886) issue of the St. Louis *Medical Journal*, asserts that creosote may be considered to possess great value as a remedial agent in the treatment of erysipelas. In such cases he applies it in the form of a solution of from 6 to 20 drops of creosote to each ounce of water, the diseased parts of the patient being constantly covered with cloths dampened in the preparation. On ulcers or wounds he suggests that it be used in the form of a thin poultice, the base of the latter being made out of pulverized elm, the strength of the creosote admixture being regulated in accordance with the virulence of the case under treatment. In common cases 10 drops of creosote to the ounce of water guarantees a solution strong enough to combat the cutaneous form of erysipelas, as also in dressings for wounds or newly-caused injuries. If the irritation gives signs of rapid spreading the solution should be strengthened up to 20 or more drops of creosote to the ounce of water. Aside from its prime feature as a curative agent, the antiseptic properties of the remedy give it important value, for it will surely nulify the tendency of improper suppuration, and so prevent septicœmia. Dr. Fox asserts that hundreds of cases of erysipelas have been treated with the creosote application, and avers that but one of these terminated fatally. He explains, however, that the failure of the single instance noted occurred in a person whose constitution had been badly run down. In the less violent cases no other remedy was employed; but when evidence was given of the need of constitutional treatment the usual appropriate tonics were administered.

They Have Done Good Work.—The Paterson (N. J.) gas suppliers are suffering from the attacks of the local "chronic growlers," and, as usual, the "afflicted" are busily engaged in bothering the heads of the editors of the Paterson newspapers with red-hot effusions describing the woes and indignities under which the Paterson gas consumers are forced to exist. Let us see just how the Paterson case stands. The gas rates at present in force are as follows: The gross charge is placed at $2 per thousand, and prompt payment secures a discount of

5	per cent.	on a monthly consumption	under	5,000 cu. ft.
10	"	" "	between	5,000 and 20,000 cu. ft.
15	"	" "	"	20,000 and 50,000 "
25	"	" "	over	50,000 cu. ft.

This gives the "unfortunate" Paterson consumer his gas supply at net rates of $1.90, $1,80, $1,70, and $1.50 per thousand cubic feet, or in accordance with his "misfortune" in having a large or small establishment to maintain. Within the last three years the Paterson gas folks have made three reductions in selling rates, and these were granted simply because those in charge of the gas supply were anxious to extend their business. The output of the company does not exceed 50 million cubic feet per annum; and while we are not strong partisans of those who control its fortunes, we are nevertheless bound to confess that they have done the "square thing" by the denizens of the locomotive building city. It does seem ridiculous that the ever-growling sorehead, who is in a continual ferment over the rascality and rapacity of the gas man, will still continue to use gas in the illumination of his shop and residence. He has the remedy in his own hands, but never seeks to exercise it. If he does not want to be "robbed" by the gas man let him order the meter taken out, and find consolation and darkness (to say nothing about smoke, scent, and danger) in the feeble flare of a candle or the sputter of an oil lamp. And just by way of a slight hint we might call attention to the interesting fact that the Paterson gas men pay out, in the shape of taxes, the neat sum of $6,000 per annum—and pay it without giving much bother to the tax collector.

To Furnish Electric Light.—It is understood that the Saratoga (N. Y.) Gas Light Company will furnish either arc or incandescent electric lights to those who wish to illuminate their places with the "light of the future." Our informant adds that an incandescent light of 300-candle power—the invention of A. S. Hickley, of Indianapolis, Ind.—is now in duty at the Adelphi Cafè; but he fails to give any further particulars in regard to it.

How Could They Expect Anything Else.—The gas war in Jersey City having been brought to a "happy termination" through consolidation and combination, the gross price of gas was placed at an all-round figure of $1.75 per thousand cubic feet. The consumers are inclined to be downhearted over the affair, but we can see no reason for their sadness. They alone are to blame for the policy which created an opposition company in the district; and while we have no doubt (if the old Jersey City Gas Light Company had

been left in undisturbed possession of the field) that gas would now be selling there at a figure no higher than $1.50 per thousand, the consumers might have been much worse treated by the present combination than is actually the case. Most prophets in this vicinity predicted, when "peace" would finally be proclaimed, that the gross rate would be adjusted at the $2 notch. The consumers ought to congratulate themselves over the present state of the case.

ORANGE (N. J.) TO LIGHT ITS STREETS WITH ELECTRICITY.—After much cogitation the Mayor and Common Council of Orange have decided to adopt an electric street lighting system. This determination was arrived at on date of July 26, and the people who are to do the work are those who manage the Fort Wayne (Ind.) Jenney Electric Light Company. The contract calls for the erection of four towers, each 125 feet in height, and each to carry five arcs, the system to be completed by the placing of 55 single pole lights. Of course, the lights are to be of the usual "2,000-candle power" sample, and are to go in duty an hour after sunset and be extinguished an hour before sunrise. The Jenney folks are to commence the lighting on the first day of October; and it is further stipulated that, after the expiration of thirty days, if the illumination is not satisfactory to the Councilmen, the electric suppliers may be required to erect as many more lights as the City Fathers deem necessary to bring the work to the desired "pitch of perfection." The contract is to run from October 1, 1886, to June 1, 1889, and the monetary consideration involved is placed at $11,000 per annum. The contract is a most peculiar one, and possibly opens the way for future trouble to the Orange taxpayers.

A NEW GAS COMPANY.—Pacific coast advices convey the information that articles incorporating the California Gas Light and Fuel Company were filed with the Clerk of the Superior Court, San Francisco, Cal., on date of July 21st. The incorporators are Messrs. C. L. Bigelow, George C. Higgins, D. P. N. Little, and John Kirkham, who report having subscribed for $49,900 capital stock out of a total proposed ultimate capitalization of $100,000.

WILL THE SCHENECTADY (N. Y.) GAS COMPANY CHANGE OWNERS.—The Schenectaday *Star*, date of July 29, contains the following: "In a recent issue it was stated that Sheriff Clute had seized all the personal belongings of the Schenectady Gas Light Company, the object being to satisfy the claims of the Schenectady Bank and a bank in Utica, amounting in all to something over $5,000, judgments having been previously obtained by those institutions. At first these proceedings seemed strange, as the Company was supposed to be in easy circumstances, and a reporter endeavored to investigate them, but met with little success in the attempt. Finally, however, he succeeded in interviewing an official of the Company, who said: 'It amounts to just this—certain parties are endeavoring to crowd Mr. Jno. McEncroe out of the Company; but they will find they can't do it' Subsequently it was learned there is a strong probability that Messrs. McEncroe and William Van Vranken will sell their stock, and the chances are the sale will be consummated within the next two or three days. No one connected with the company evidenced a desire to talk about the affair, but the following particulars—and they are thought to be authentic—were collected. Messrs. McEncroe and Van Vranken own two-thirds of the capital stock of the Schenectady Gas Light Company—the total paid-in capital amounts to $100,000—and they value their holdings at a trifle over par, or say about $68,000 for the lot. It is stated that certain Philadelphia capitalists have made an offer of $58,000 for the McEncroe and Van Vranken holdings, with a further likelihood that a subsequent bid will be made which will result in securing a transfer." It is a pity that the owners of the old Schenectady gas plant cannot harmonize their differences. The situation is a good one, and could be made still better. Let us hope the affair will be amicably adjusted.

INCREASING THE CAPITAL STOCK.—At a meeting of the stockholders of the Citizens Gas Light Company, held at the office of the Company, in Port Chester, N. Y., on date of July 21st, it was unanimously resolved to increase the capital stock of the corporation to $500,000. This represents an addition of $200,000, and those in charge of the undertaking explain that the augmentation was made necessary to meet the expenditure involved by a decided alteration in the scale of working originally proposed. A much larger territory is to be supplied with gas than that formerly determined upon; but despite the change in the plans Engineer Olney asserts that the work will be completed within the time originally specified, and that the Company will be ready to supply the demands of consumers at an early day in the coming fall season.

FIXING THE RATES.—At a meeting of the board of directors of the Natural Gas Company of West Virginia, held in Wheeling, West Va., on July 20, the rates at which it was proposed to supply natural gas in that city came up for discussion. It was finally determined to promulgate the following schedule, applicable only to those embraced within the class known as "ordinary users of gas for domestic purposes." Each cooking stove, $2 per month for seven months, and five months free, or $14 for the year. For the first grate or heating stove, $1.70 per month for seven months, and five months free, or $11.90 for the year; for each additional grate or heating stove, $1.50 per month for seven months, and five months free, or $10.50 for the year. The resolution, in dealing with "extraordinary users," reads, "When the Company's gas is used in manufacturing establishments, or in bakeries, or in places where a large amount of gas is steadily consumed, special contracts will be made." The names of those in charge of the Company are as follows: President, C. W. Batchelor; Secretary, Geo. Heard; Directors, J. J. and T. J. Vandergrift, H. Fisher, J. W. Craig, and J. I. Buchanan, of Pittsburgh, Pa., with A. J. Sweeney, Thos. O'Brien, and J. G. Hoffman, of Wheeling.

GUARANTEEING A PLENTIFUL SUPPLY OF GAS FOR GERMANTOWN.—Chief Engineer Park, of the Philadelphia Gas Trust, started his men at work, on July 26th, on the task of putting down the new 12-inch main which is to replace the present connection from the Ninth Ward works of the Trust to the suburb of Germantown—an improvement which should have been made at least five years ago. The line will run from Ninth street and Lehigh avenue out Lehigh avenue to Broad street, to Venango street, and thence on to the township line. Although much rock will be encountered in the progress of the job, that is probably the safest route to follow. It is expected to finish the line by December 15th, and if the expectation is to be realized, Mr. Park will be kept on the go. Work on the new benches of the Trust progresses most satisfactorily; in fact it is quite certain some of the stacks will be in duty on October 1st.

THEY WERE IN ADDITION TO THE OTHERS.—In our last issue we mentioned the fact that the authorities of Philadelphia, Pa., had contracted with the Siemens-Lungren Company for the erection of a total of 95 high-power lamps to be placed in certain named squares of the Quaker City. It should be borne in mind that the new allotment was in addition to those which have been and are maintained on Franklin, Logan and Rittenhouse squares. We herewith reproduce the location and number of Siemens lamps at present ordered by the municipality: Franklin, 22; Logan, 26; Rittenhouse, 24; Passayunk, 16; Jefferson, 16; Norris, 18; Washington, 23; Independence, 21—also one lamp on the northeast corner of Twentieth and Tioga streets, or a total of 167. The illumination is a success in every particular, and the Philadelphians are quite enthusiastic over the utility and beauty of the system.

LIGHTING THE STREETS WITHOUT CHARGING FOR THE WORK.—Under the contract recently entered into between the city authorities and the Memphis Gas Light Company the city's public lighting is performed by the gas men without charge. Under this arrangement the taxpayers save a sum almost equal to $17,000 per annum—taking last year's expenditure in that direction as a guide. Possibly we could induce Mr. Ensley to send us a copy of the contract. At any rate, we herewith extend the invitation, and assure him of our hearty thanks if he accepts.

WITHOUT GAS.—Owing to the peculiar efforts of Col. Jno. D. Watson, late lessee of the Vineland (N. J.) Gas Works, that town was plunged in darkness at the end of last month. Mr. Jno. K. Farnum, of Waltham, Mass., is the owner of the plant, and by the time Mr. F. is through with the Colonel that warlike gentleman will be compelled to haul down his colors. The Vineland plant was built by Davis & Farnum, of Waltham, Mass., at a cost of about $59,000. Subsequently the works were put up at auction at a receiver's sale (in 1884), and purchased by Mr. Farnum.

THE SALE CONFIRMED.—The Chicago (Ills.) *Inter-Ocean*, of July 27th, says that Judge Blodgett entered an order (July 25th) confirming the sale—reported in issue of JOURNAL for Aug. 2d—of the plant, property and assets of the Consumers Gas, Fuel and Light Company to Jno. T. Lester, the nominal purchaser at the chancery sale, for $1,946,000. The objections made by Cunningham Brothers, of Philadelphia, Pa., have been withdrawn. They having been settled with, Lester is to deposit with the Master-in-Chancery Sherman, as security for the payment of his bid, bonds of the gas company secured by its trust deed with all unpaid interest coupons and receiver's certificates, which are made first liens on the property of the company, and pay in cash the remainder of his bid, after deducting therefrom 80 per cent. of the face value of the receiver's certificates and bonds, and the $50,000 already paid by him. Upon this being done the receiver is to turn over the whole property to Mr. Lester.

THE PATENT OFFICE BALANCE, ETC.—According to the official figures the U. S. Patent Office business for the year ended December 31st, 1885, returned a profit of $163,710.30. That sum added to the balance on hand from previous years, makes the available cash surplus to the credit of the depar

ment foot up to $2,945,405.58. The applications for patents during the year numbered 34,697; designs, 862; reissues, 158; in all, 35,717. Caveats filed, 2,552; trademarks, 1,220; labels, 728. The first patent ever issued by the Government bore date of July 28, 1836; the first reissue occurred in 1838. The first trade mark appeared in 1870, and the first label in 1874. Patents to the number of 12,691 expired in 1885. The number of foreign patents granted in year is recorded at 1,549, of which 549 are accredited to residents of England.

To Furnish Electric Light.—Mr. F. H. Parker, Supt. of the Burlington (Vt.) Gas Light Company, informs us that his board of directors ratified a resolution to purchase a controlling interest in the stock of the Brush-Swan Electric Light Company, of Burlington. The electric plant, he explains, would go into operation at an early date in the present month, and the prospect was that 50 street lights and 20 commercial lights would embrace the initial service. As we understand it, only arc lights are to be supplied.

No Electric Light for Warren, Ohio.—The electricians have been endeavoring to convince the Common Councilmen of Warren that it would be a good thing to light the city's streets with electricity, and it looked for a time as if they would be successful in the attempt. However, Brother Geo. H. Tayler, of the Warren Gas Light Company, undertook to throw some light on the scheme, and his attempt was rewarded in the passage of a resolution by the Council, at a meeting held July 23, which asserted that "the city was not prepared to enter into a contract with any electric light company at the present time." Warren, during the year 1885, paid the gas company a trifle over $1,300 for the lighting of the streets, while the proposition submitted by the Western Electric Light Company called for an expenditure of $2,520 per annum. These, of course, are not imposing figures; but the evidence of economy is all in favor of the modest contract held by the gas folks. The authorities, in reply to action taken by them some three months ago, or when they asked the Warren Gas Company to name figures at which it would agree to maintain the gas lamps if an increase in their number were ordered, were informed that, should a total of 80 posts be agreed upon, the charge for each would be fixed at $20 per annum—on the basis of a two years' contract. This, of course, implies the use of a moon-table. The offer was then refused; but perhaps the city officials may now see their way clear to accept it.

Of Course.—The Poughkeepsie (N. Y.) authorities having acted in haste are repenting at leisure; but in the meantime the local electric light company keeps on in the even tenor of its way—that is, in an "evenly bad" way. The streets are wretchedly illuminated, and, in response to numerous complaints, Alds. Cunley and De Garmo have asked that the Board make an official inspection of the style in which the electric manipulators have carried out their contract pledges. The inspection is to be made *en masse* and *incog.*

Cheaper Gas for Tyrone, Pa.—Supt. C. H. Dieffenbaugh informs us that the directors of the Tyrone Gas and Water Company have instructed him to notify their patrons of the following new schedule of rates: Gross price to be placed at $2 per thousand, payment of accounts within five days from date of presentation to entitle the consumer to the following discounts, according to his grade:

All bills rendered for less than $5...	10	per cent.	off.
" over $5 and under $50.....	15	"	"
" over $50.....	20	"	"

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The *Mechanical World* says: It is or ought to be known to practical men concerned in the working of wrought iron that a piece of the very best and toughest iron, hammered in the process of forging until it ceases to be red-hot, becomes so brittle that it will in many cases break across in the treatment, or if it does not at that time, this process of cold hammering has so removed and destroyed its tenacity as to render it capable of being broken with the slightest blow. What renders the knowledge of the effects of such a process the more important is that, in most cases, in order to give forged work the requisite finish and fine surface, as it comes from the hands of the workmen, the very cold hammering, or swaging, as it is termed, is required, the more so as it is by such a process that iron forgings are so finished from the hammer as to require the least possible labor after, and as every good workman in that department is anxious to turn his work out of hand with the very best surface on it, which this cold hammering enables him to do, it is not a very easy matter, and not at all desirable to desire them to discontinue the practice, which many have endeavored to do, from want of a full knowledge of the subject. There is nothing inherently wrong in this practice of cold hammering—far otherwise; the evil rests with the applying such a cold-hammered piece of forge work to its purpose without having been passed through the curative process, which is simply this: to heat the piece of forged work in question to a dull red heat, and lay it down to cool at its leisure. By subjecting wrought iron to the most violent hammering or compression at a low temperature, and then submitting the iron work so treated to the simple process of heating red-hot and slow cooling, we enhance its tenacity or shock-sustaining qualities at least twenty times.

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Metropolitan, Bonds	658,000	—	113	—
Mutual	3,500,000	100	110	112
" Bonds	1,500,000	1000	104	107
Municipal, Bonds	750,000		—	—
Northern	125,000	50	—	—
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Richmond Co., S. I.	300,000	50	50	—
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" S. F. Bonds	320,000	1000	106	110
Fulton Municipal	3,000,000	100	150	153
" Bonds	300,000		104	108
Peoples	1,000,000	10	70	72
" Bonds	290,000	—	106	107
" "	250,000	—	103	—
Metropolitan	1,000,000	100	87	—
Nassau	1,000,000	25	113	115
" Ctfs	700,000	1000	101	102
Williamsburgh	1,000,000	50	133	—
" Bonds	1,000,000	—	112	114
Out of Town Gas Companies.				
Buffalo Mutual, N. Y.	750,000	100	85	90
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	130	140
" " Bonds	124,000	—	105	110
Chicago Gas Co., Ills	5,000,0000	25	128	135
Peoples G. L. & C. Co., Chicago, Ills	3,000,000		8	12
Cincinnati G. & C. Co.			190	194
Consolidated, Balt.	6,000,000	100	55½	—
" Bonds	3,600,000		107	107½
Chesapeake, Balt	1,500,000	100	73	75
"	1,000,000		100	102
Central, S. F., Cal.			70	72
Capital, Sacramento, Cal.			54	56
Hartford, Conn	750,000	25	140	142
Jersey City	750,000	20	155	160
Laclede, St. Louis, Mo.	1,600,000	100	97	99
Louisville, Ky.	1,500,000	50	118	121
Montreal, Canada	2,000,000	100	209	215
New Haven, Conn		25	190	195
Oakland, Cal.			35	35½
Peoples, Jersey City		—	25	30
" " Bonds			—	—
Paterson, N. J.		25	90	—
Rochester, N. Y.		50	75	80
St. Louis, Missouri	600,000	50	—	475

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ment foot up to $2,945,405.58. The applications for patents during the year numbered 34,697; designs, 862; reissues, 158; in all, 35,717. Caveats filed, 2,552; trademarks, 1,220; labels, 728. The first patent ever issued by the Government bore date of July 28, 1836; the first reissue occurred in 1838. The first trade mark appeared in 1870, and the first label in 1874. Patents to the number of 12,691 expired in 1885. The number of foreign patents granted in year is recorded at 1,549, of which 549 are accredited to residents of England.

To Furnish Electric Light.—Mr. F. H. Parker, Supt. of the Burlington (Vt.) Gas Light Company, informs us that his board of directors ratified a resolution to purchase a controlling interest in the stock of the Brush-Swan Electric Light Company, of Burlington. The electric plant, he explains, would go into operation at an early date in the present month, and the prospect was that 50 street lights and 20 commercial lights would embrace the initial service. As we understand it, only arc lights are to be supplied.

No Electric Light for Warren, Ohio.—The electricians have been endeavoring to convince the Common Councilmen of Warren that it would be a good thing to light the city's streets with electricity, and it looked for a time as if they would be successful in the attempt. However, Brother Geo. H. Tayler, of the Warren Gas Light Company, undertook to throw some light on the scheme, and his attempt was rewarded in the passage of a resolution by the Council, at a meeting held July 23, which asserted that "the city was not prepared to enter into a contract with any electric light company at the present time." Warren, during the year 1885, paid the gas company a trifle over $1,300 for the lighting of the streets, while the proposition submitted by the Western Electric Light Company called for an expenditure of $2,520 per annum. These, of course, are not imposing figures; but the evidence of economy is all in favor of the modest contract held by the gas folks. The authorities, in reply to action taken by them some three months ago, or when they asked the Warren Gas Company to name figures at which it would agree to maintain the gas lamps if an increase in their number were ordered, were informed that, should a total of 80 posts be agreed upon, the charge for each would be fixed at $20 per annum—on the basis of a two years' contract. This, of course, implies the use of a moon-table. The offer was then refused; but perhaps the city officials may now see their way clear to accept it.

Of Course.—The Poughkeepsie (N. Y.) authorities having acted in haste are repenting at leisure; but in the meantime the local electric light company keeps on in the even tenor of its way—that is, in an "evenly bad" way. The streets are wretchedly illuminated, and, in response to numerous complaints, Alds. Cunley and De Garmo have asked that the Board make an official inspection of the style in which the electric manipulators have carried out their contract pledges. The inspection is to be made *en masse* and *incog.*

Cheaper Gas for Tyrone, Pa.—Supt. C. H. Dieffenbaugh informs us that the directors of the Tyrone Gas and Water Company have instructed him to notify their patrons of the following new schedule of rates: Gross price to be placed at $2 per thousand, payment of accounts within five days from date of presentation to entitle the consumer to the following discounts, according to his grade:

All bills rendered for less than $5...	10	per cent.	off.
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Metropolitan	1,000,000	100	87	—
Nassau	1,000,000	25	113	115
" Ctfs	700,000	1000	101	102
Williamsburgh	1,000,000	50	133	—
" Bonds	1,000,000	—	112	114
Out of Town Gas Companies.				
Buffalo Mutual, N. Y.	750,000	100	85	90
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	130	140
" " Bonds	124,000	—	105	110
Chicago Gas Co., Ills	5,000,0000	25	128	135
Peoples G. L. & C. Co., Chicago, Ills	3,000,000		8	12
Cincinnati G. & C. Co.			190	194
Consolidated, Balt.	6,000,000	100	55½	—
" Bonds	3,600,000		107	107½
Chesapeake, Balt	1,500,000	100	73	75
"	1,000,000		100	102
Central, S. F., Cal.			70	72
Capital, Sacramento, Cal.			54	56
Hartford, Conn.	750,000	25	140	142
Jersey City	750,000	20	155	160
Laclede, St. Louis, Mo.	1,600,000	100	97	99
Louisville, Ky.	1,500,000	50	118	121
Montreal, Canada	2,000,000	100	209	215
New Haven, Conn.		25	190	195
Oakland, Cal.			35	35½
Peoples, Jersey City		—	25	30
" " Bonds			—	—
Paterson, N. J.		25	90	—
Rochester, N. Y.		50	75	80
St. Louis, Missouri	600,000	50	—	475

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To Gas Companies, Engineers, and Municipal Bodies.

WANTED, AN ENGAGEMENT AS ENGINEER OR MANAGER OF GAS OR WATER WORKS. Twenty-five years' experience in England, Ireland, S. America, and the West Indies. Speaks Spanish. A thorough practical knowledge of mechanical engineering; a good draughtsman. First-class testimonials and references. Disengaged in December. Address

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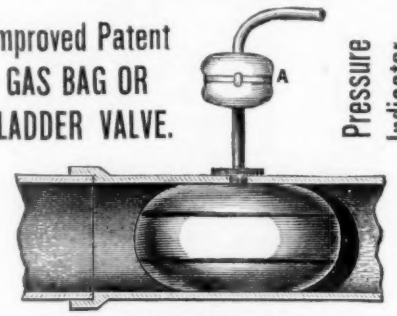

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Increase the demand for Coke by using the
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SIMPLE, CHEAP, DURABLE. EASILY SHARPENED BY ANY BLACKSMITH.
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SELF-LIGHTING!

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This Gas Burner, which is in reality an enriching gas machine, increases the illuminating power of ordinary coal or water gas to a point where it is comparable only to the dazzling brilliancy of the electric arc. Our new "Carboncrystal" (see below) has been prepared specially for this light, and is better adapted to it. It is purer than anything ever before used for this purpose. Under our newly introduced system of filling vessels *no attention whatever* is required to our lights on the part of the consumer.

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A new and superior preparation for enriching gas used in conjunction with Crystal Carbon or Albo-Carbon gas lights. The preparation is cleaner and better adapted for filling burner vessels than any hitherto produced. Guaranteed to be chemically pure. Supplied in cans from 10 pounds up.

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New and Improved Regenerative Furnace.

ESPECIALLY ADAPTED FOR USE IN SMALL GAS WORKS.

A Saving of at Least Forty per Cent. over Old Methods.

Cheapness of construction and absence of elaboration are the chief characteristics of this Furnace. It is also applicable in cases where it is not convenient to excavate deeply below the line of the retort house.

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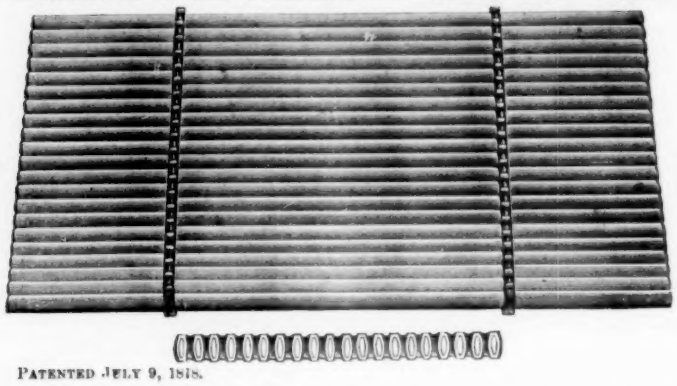

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References in all parts of the country. Send for circular and list of companies who now have the Screen in use.

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FOR UTILIZING COAL TAR AS FUEL.

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FOR CLEANING BOILER TUBES.

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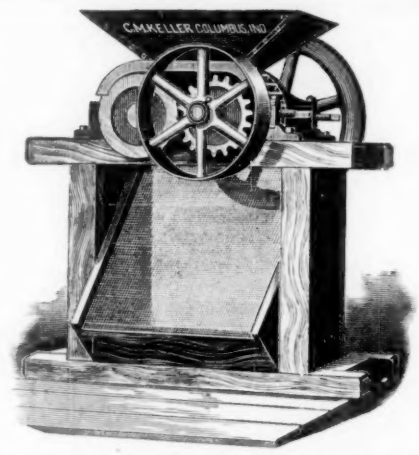

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MINER'S PATENT STREET LAMPS.

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Marvelously Sensitive!

It is a Silent and Ever Faithful Servant!

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Gratifies Managers by Removing a LOAD OF RESPONSIBILITY, and Insuring Perfect Distribution at all Times with Minimum Pressure!

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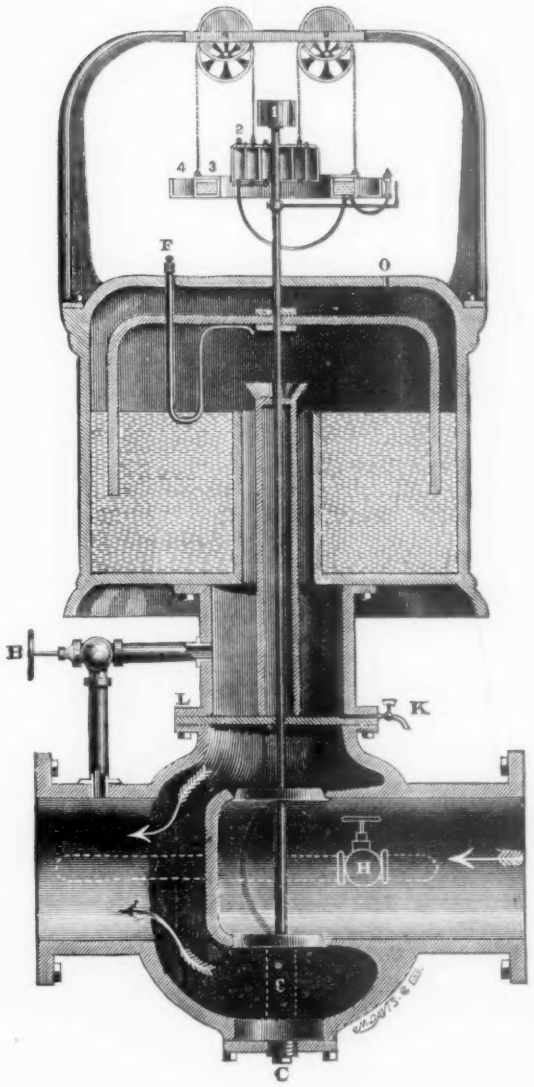

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Gentlemen—Enclosed please find draft covering our account. The Governor has worked perfectly, and will soon save its cost. Our circumstances are such that we cannot get the full benefit; but we are *more than satisfied.*

Yours truly

C. D. FLANIGEN, Agent.

Plainfield, N. J.

PLAINFIELD GAS LT. CO., PLAINFIELD, N. J., March 8, 1886.

Messrs. CONNELLY & CO., LTD., 177 Broadway, N. Y.:

Gentlemen—Enclosed please find check to your order covering our account in full. We are very much pleased with the Governor, and are satisfied that *it does just what you claim for it.* Yours truly,

H. G. RUNKLE, Treas.

Evanston, Ill.

NORTHWESTERN GAS LT. AND COKE CO., EVANSTON, ILL., April 6, 1886.

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Pottstown, Pa.

POTTSTOWN GAS LT. CO., POTTSTOWN, PA., March 9, 1886.

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Yours truly,

L. P. EVANS, Treas.

Palatka, Fla.

PALATKA GAS LT. AND FUEL CO., PALATKA, FLA., May 28, 1886.

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Regarding your Automatic Governor, will say it has been in operation several months, and our Superintendent says "*it works perfectly.*"

Very respectfully,

W. J. WINEGAR, Prest.

THE ALBO-CARBON LIGHT!

A new system of Carburetting heated Gas by means of a solid material, whereby its illuminating power is increased more than three-fold.

SUPERIOR TO ALL OTHER SYSTEMS FOR

Economy, Safety, Illuminating Power and General Practicability,

The Albo-Carbon process enables Gas Companies to supply a light equal to the Arc Light, at a much less cost. Several Gas Companies are now using this system. The process is extensively used in Europe, and is being rapidly adopted in this country.

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37 Weybosset Street, Providence, R. I.
53 to 55 German St., Baltimore, Md.
91 and 93 Fifth Ave., Pittsburgh, Pa.
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100 Woodward Ave., Detroit, Mich.

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AUTOMATIC DIFFERENTIAL GAS GOVERNOR

Is now in Practical Operation, doing Perfect Automatic Service with Great Precision.

Others (6, 8, 12 and 16 inch) are now being set; and many more to be shipped soon.

BE SURE TO THOROUGHLY INVESTICATE THE SUPERIOR MERITS OF THIS COVERNOR BEFORE PURCHASING.

For Simplicity and Reliable Work it has no Equal. Correspondence Solicited.

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System Drs. Schilling and Bunte.

Greatest Durability! Minimum of Attention!

COMPLETE DISTILLATION IN 3½ HOURS.

Ten to Thirteen Pounds of Coke to Hundredweight of Coal.

NO CLINKER. NO CARBONIC OXIDE IN THE REGENERATIVE FLUES.

Almost Automatic in Action.

The Most Successful Regenerative Furnace in Use.

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Agents for the United States.

The Champion Gas Generators.

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These Generators are designed to manufacture Siemens Gas (30% combustible), Water Gas (carbonic oxide and hydrogen, non-illuminating), or Carburetted Hydrogen (illuminating gas of any candle power desired),

From Any Combustible Material, More than Twice as Fast, and at Less than Half the Cost,

As compared with the best regenerative coal bench or water gas apparatus in the market. Drawings and specifications can be obtained from the Commissioner of Patents, Washington, D. C., and are also in the hands of the principal builders of gas works in Richmond, Philadelphia, Baltimore, New York, Brooklyn, Waltham, Cincinnati, Fort Wayne, and Chicago, from whom estimates can be obtained of cost of any size o Generators required. **$2,000 Reward** to any gas experts or inventors (for their own benefit) who can design superior processes and apparatus without infringing upon the United States patents above mentioned. For terms of use apply to

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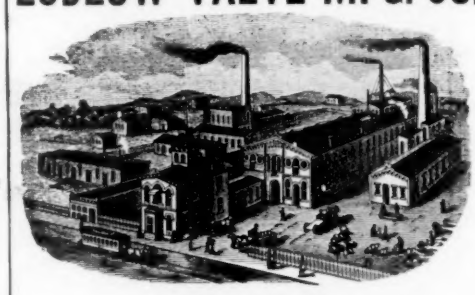

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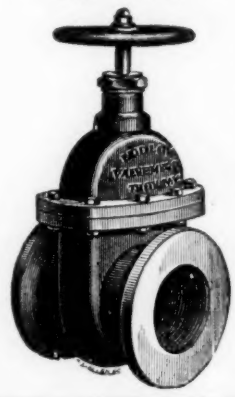

Valves.—Double and Single Gate, ½ in. to 48 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, and Oil.

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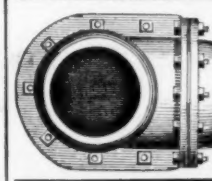

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GLOBE OR ANGLE VALVE.

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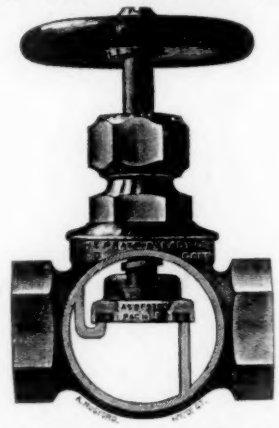

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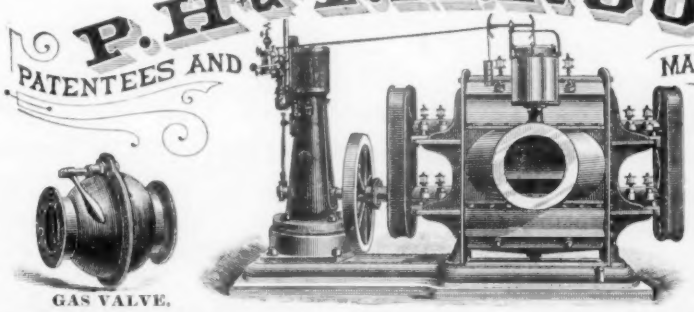

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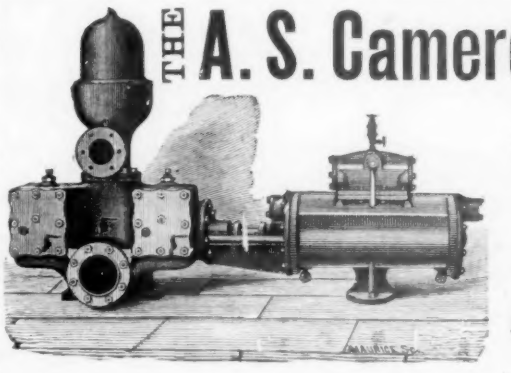

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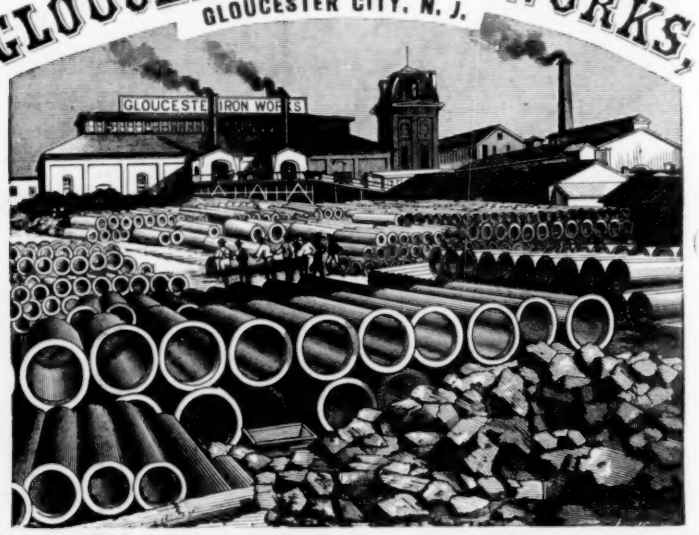

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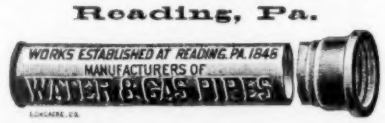

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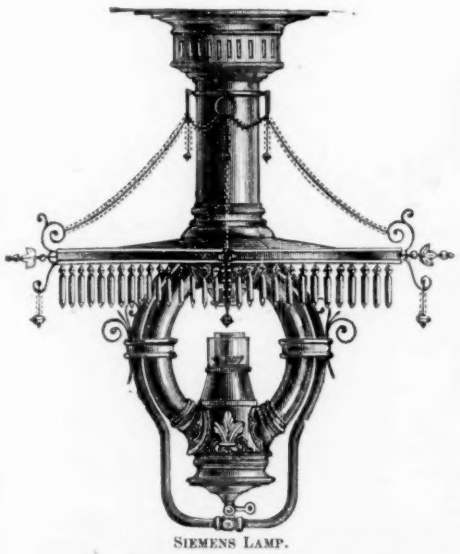

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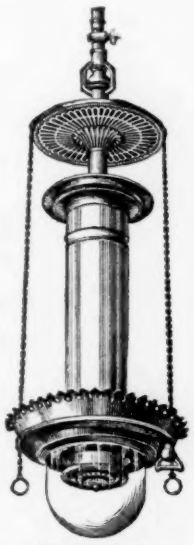

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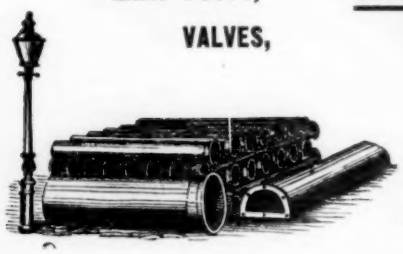

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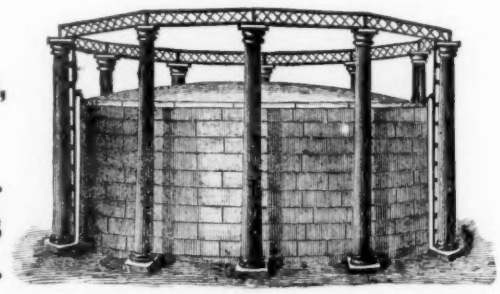

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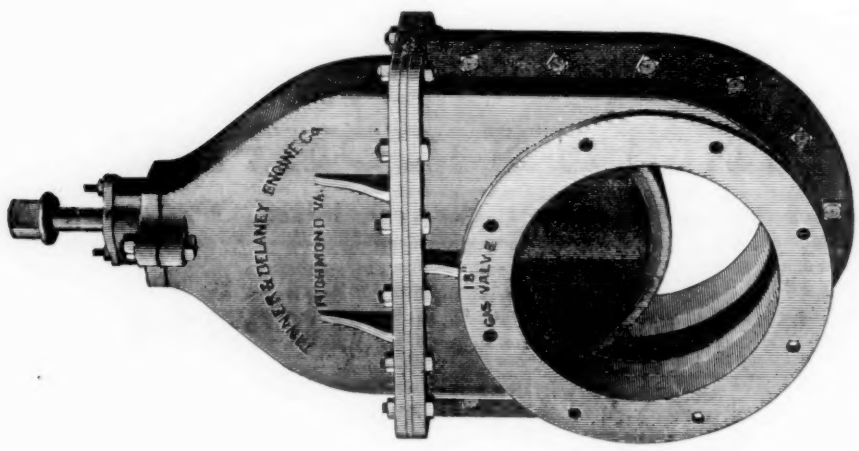

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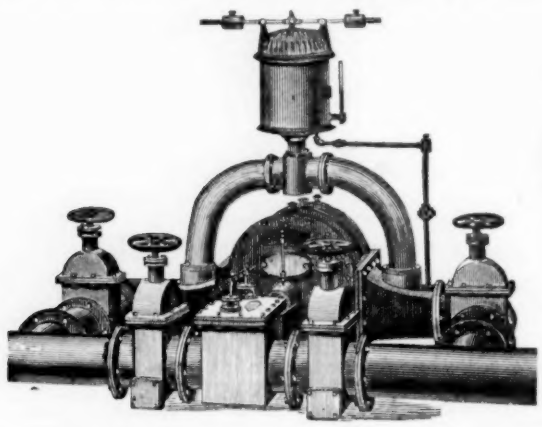

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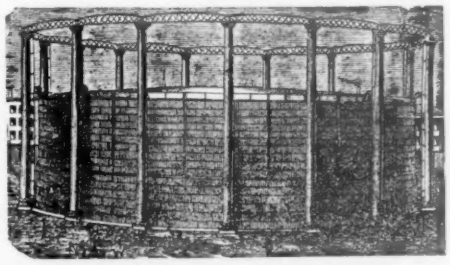

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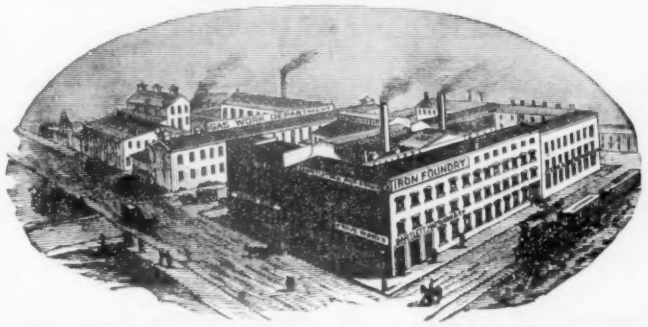

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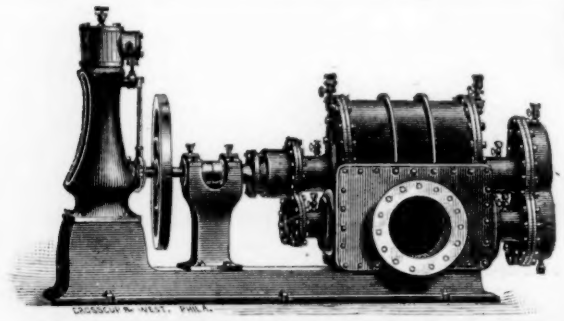

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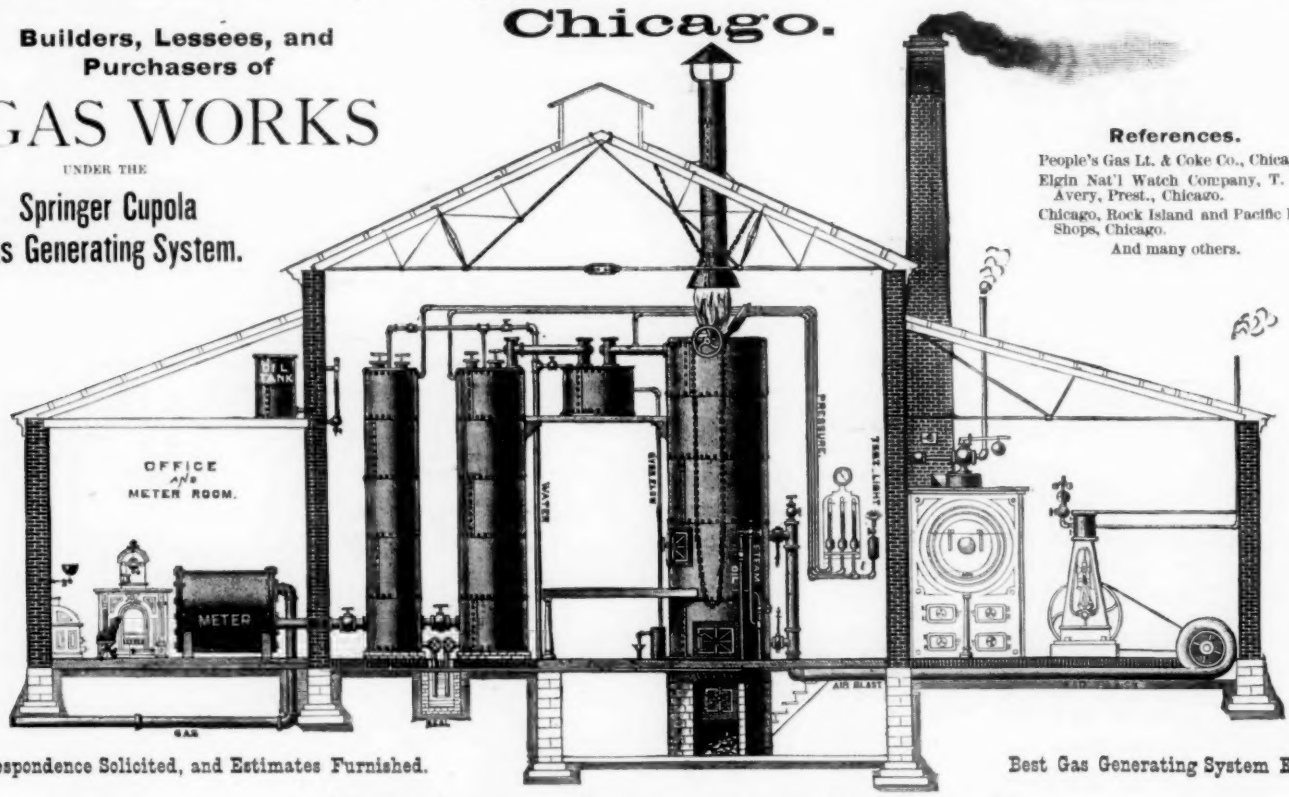

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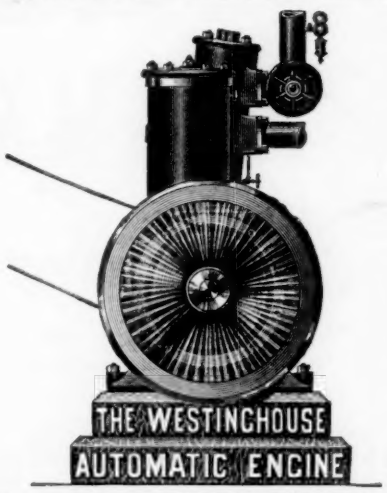

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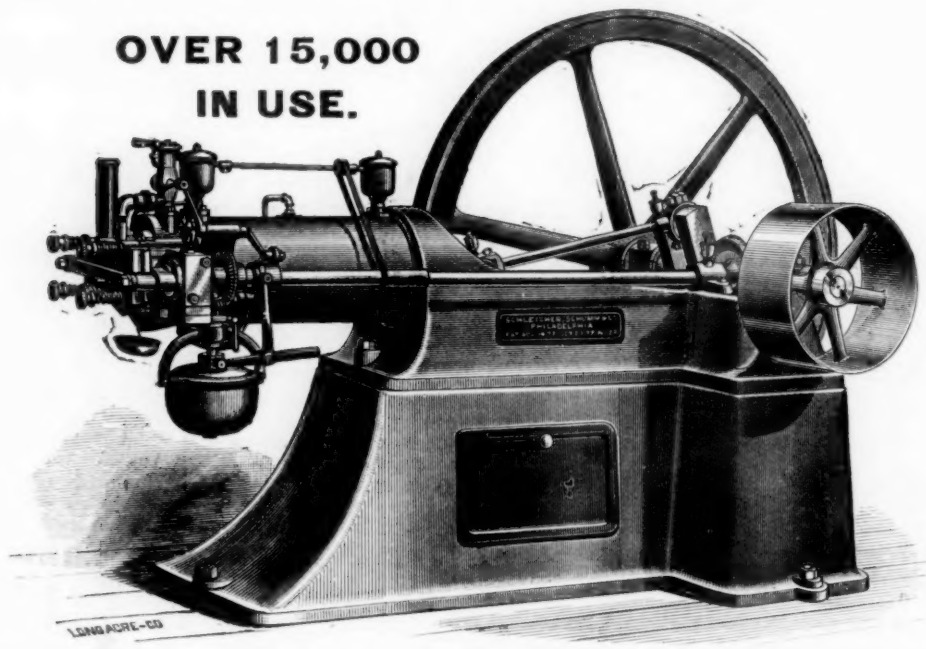

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